

Statement of the National Academy of Sciences on the AEC Fellowship Program

The provision for loyalty and security investigation of all Atomic Energy Commission fellows, included in a rider to the 1950 Independent Offices Appropriation Act passed by Congress last August, has far-reaching implications for scientists and scientific freedom. It posed an immediate problem to the National Academy of Sciences: whether or not its National Research Council should continue to administer the AEC fellowship program under the new restrictions. A quasi-governmental body, the NRC accepts an obligation to give any advice it can to a government agency that asks it. But discussions within the Academy and the NRC revealed almost unanimous opposition to the application of clearance procedures to fellows working in nonsecret areas.

When the AEC asked for advice on the future direction of its fellowship program the Academy replied:

We are convinced that by this restriction the value of the broad program has been greatly reduced; we have grave doubts whether [its] continuance . . . thus restricted is in the national interests. . . .

Since we hold these views, we believe that the National Research Council should not accept the responsibility for administering the altered fellowship program.

We hope that, to the extent to which the Atomic Energy Commission continues the program, it will find it possible to administer it without our help. Nevertheless, in the measure in which our advice in one form or another may prove necessary to the Commission, we recognize an obligation to provide such advice.

We would further urge the Atomic Energy Commission to take all proper steps to see that these restrictive provisions be omitted from future legislation. We in turn shall make known to the Government of the United States the reasons for the views here expressed.

The AEC considered and rejected this suggestion that it should take over administration of the program, stating as its reasons:

1. The AEC believes any fellowship program affecting a substantial number of students training in broad and established fields of science should be administered by a scientific or educational organization. While an executive agency of the Government may properly sponsor such a program, it should not administer it.

2. The National Academy of Sciences, the senior agency for cooperation between the Government and the scientific community, has gone on record as opposing FBI investigation of fellows appointed to nonsecret work. It would be extremely difficult to administer an effective fellowship program that did not have the full support of the scientific community.

Further consultation and correspondence between officials of the Academy and those of the AEC led to agreement on a contract for NRC administration of a fellowship program for 1950-51 revised to meet the new conditions. No new predoctoral fellowships will be offered for 1950-51. Postdoctoral fellowships will be limited to work requiring secret information. To fulfill prior commitments, applications for renewal of current nonsecret predoctoral fellowships and postdoctoral medical fellowships will be accepted, subject to the clearance provisions. It is expected that about 75 new awards will be offered and about 175 renewals granted. There are now 421 AEC fellows, 30 engaged in secret work and 391 in nonsecret work.

The statement by the National Academy of Sciences is reproduced here, together with related correspondence between the Academy and the AEC.

IN AUGUST 1949, the Congress passed an amendment to the Independent Offices Appropriation Act of 1950 which requires that holders of Atomic Energy Commission fellowships must be given clearance from the AEC after having been investigated as to character, associations, and loyalty by the Federal Bureau of Investigation. On the basis of the record of the hearings before the Joint Congressional Committee, this enactment is believed to carry the implication that the fellowship program is designed to provide the nation with scientists who are not only trained to utilize knowledge of nuclear energy and fissionable materials in their study of problems in physics, biology, medicine, etc., but who also would be available for work associated with the classified activities of the AEC.

To explore means for meeting this implication and at the same time discharging its statutory obligation to render assistance within its competence to any government agency requesting it, the National Academy

of Sciences held discussions within its council and membership and its officials met with those of the AEC. To carry out the decisions thus reached, the Academy has agreed to enter into a contract proposed by the AEC, under the terms of which the NRC will administer during 1950-51 a new program of fellowships, limited in scope and differing in character from that previously in force.

Commitments for renewals for 1950-51 of fellowships awarded for 1949-50, as published in previous NRC announcements, will be fulfilled, subject, however, to the provisions of the new law.

The revised fellowship program was developed after the AEC had been informed of the opinions of the council of the Academy regarding the influence of the new restrictions and of its members' convictions concerning the responsibilities of the Academy to American science, as well as to the Government of the United States. It is described in the following letter.

Letter dated December 9 from Carroll L. Wilson, general manager of the U. S. Atomic Energy Commission, to Alfred N. Richards, president of the National Academy of Sciences:

"The Commission has carefully considered the conditions set forth in your letter of November 30 under which the National Academy is willing to authorize the National Research Council to administer a new and more limited Atomic Energy Commission Fellowship Program. The Commission plans to explore further the desirability of sponsoring in some way a predoctoral fellowship program in fields relating to atomic energy. It intends, of course, to seek the advice of the Academy on this question. In the meantime the Atomic Energy Commission requests the National Academy of Sciences to authorize the National Research Council to administer a program of Atomic Energy Commission fellowships in accordance with the following conditions:

"1. Predoctoral fellowships will not be offered by the National Research Council for the academic year 1950-51.

"2. In order that commitments in announcements of the predoctoral fellowships and of the postdoctoral medical fellowships for 1949-50 shall be fulfilled, applications for renewal of current fellowships in these categories will be solicited by the National Research Council and renewal recommended for those whose progress warrants it. However, because of the amendment to the Independent Offices Appropriation Act of 1950, such recommendations can become effective only after the applicant has been investigated as to character, associations and loyalty by the Federal Bureau of Investigation and clearance given by the Atomic Energy Commission. Hence those whose applications for renewal are approved by the National Research Council will receive from the Atomic Energy Commission a copy of the amendment referred to above and a personnel security questionnaire which must be filled out and returned before the FBI investigation can be initiated. Decisions by AEC, based upon the FBI report, will determine the fellowship awards.

"3. The National Research Council will administer a limited program of postdoctoral fellowships in the physical sciences, biology, biophysics and medicine for advanced training in fields of secret work or in problems which require access to restricted data. For holders of these fellowships, FBI investigation and full security clearance constitute an accepted requirement.

"In the physical sciences, the fields of study will be limited to those closely related to the Atomic Energy Commission program, such as the chemistry and nuclear physics of elements of atomic number 90 and above, the neutron physics of the elements, the effect

of high energy radiation on matter, the chemistry of elements in the fission product range, and the separation of isotopes.

"In biology, biophysics, and medicine, the research fields will include experimental aspects related to atomic energy which require the use of the special facilities available in the AEC installations and/or access to restricted data. This work would include studies such as the physiological and toxicological effects of fission products, and the development of radiation instruments as applied to biological and health physics problems of a classified nature.

"4. The administrative commitments set forth in this letter do not extend beyond June 30, 1951.

"We understand from your letter of November 30, 1949 that the National Academy of Sciences agrees to the provisions enumerated above. Members of the staff of the Commission will arrange with the National Research Council for the implementation of this fellowship program and for public announcement of the revised program."

The correspondence that led up to Mr. Wilson's letter of December 9 follows.

Letter dated September 27 from Carroll L. Wilson, general manager of the U. S. Atomic Energy Commission, to A. N. Richards, president of the National Academy of Sciences:

On August 18, 1949, Mr. Carleton Shugg, Deputy General Manager, wrote to you calling attention to the provision of the Independent Offices Appropriation Act which concerns fellowships. At that time the immediate legal obligations particularly in relation to the renewal of present fellowships were emphasized. At this time it seems appropriate to initiate a general consideration of the future scope and character of the fellowship program. The recommendations of the National Academy of Sciences and the National Research Council in these matters will be welcomed.

Letter dated November 2 from Alfred N. Richards, president of the National Academy of Sciences, to Carroll L. Wilson, general manager of the U. S. Atomic Energy Commission:

In your letter of 27 September 1949, addressed to the National Academy of Sciences, you have stated that recommendations of the National Academy of Sciences and the National Research Council concerning future scope and character of the Atomic Energy Commission fellowship program would be welcomed. The question has accordingly been made the subject of lengthy discussion by the Council of the Academy, the opinions of the entire membership of the Academy have been solicited, and at two business sessions of the Academy at its meeting in Rochester, October 24-26, the question was thoroughly debated and the sense of the meeting ascertained.

The attached statement was drawn up by the Council of the Academy and submitted for discussion to those members of the Academy who attended the autumn meeting. It may be regarded as representing the opinion of the Council and of a large majority of the members who have had the opportunity of discussing it.

It might clarify your understanding of the second part of the second sentence of the second paragraph if I tell you that the wording of that sentence is a last-minute change made at an informal meeting of the Council from a sentence which read as follows: "We have grave doubts whether a program thus restricted is more in the national

interest than no such broad AEC fellowship program at all."

The part of the statement entitled "Annex" is to be regarded as an appendix which might be made the subject of discussion with you.

STATEMENT CONCERNING THE AEC FELLOWSHIP PROGRAM
PREPARED BY THE COUNCIL OF THE NATIONAL ACADEMY
OF SCIENCES AND SUBMITTED BY ITS PRESIDENT

The Council of the National Academy of Sciences has considered the request of the Atomic Energy Commission for advice as to the scope and future of the fellowship program, in the light of the restriction placed upon it by the amendment to the Independent Offices Appropriation Act of 1950.

In our opinion the requirement of FBI investigation and Atomic Energy Commission clearance is ill-advised for those fellows who neither work on secret material, nor are directly preparing for work on Atomic Energy Commission projects. We are convinced that by this restriction the value of the broad program has been greatly reduced; we have grave doubts whether the continuance of the Atomic Energy Commission Fellowship Program thus restricted is in the national interests. In these views we concur with the opinion expressed by the Executive Board of the National Research Council.

Since we hold these views, we believe that the National Research Council should not accept the responsibility for administering the altered fellowship program.

We hope that, to the extent to which the Atomic Energy Commission continues the program, it will find it possible to administer it without our help. Nevertheless, in the measure in which our advice in one form or another may prove necessary to the Commission, we recognize an obligation to provide such advice.

We would further urge the Atomic Energy Commission to take all proper steps to see that these restrictive provisions be omitted from future legislation. We in turn shall make known to the Government of the United States the reasons for the views here expressed.

ANNEX

1. We hope the Atomic Energy Commission will itself operate this program.
2. We regard it as a proper function to advise on setting up Atomic Energy Commission panels to select fellows.
3. If it is not possible for the Atomic Energy Commission to set up panels, the National Research Council will upon request make an assessment of the qualifications of the fellows and a report on the progress of their work.

4. Announcements should be made by the Atomic Energy Commission and the extent of the participation if any of the National Research Council should be made clear.
5. In announcing the fellowships we believe it the duty of the Atomic Energy Commission to see that the prospective fellows are told the nature of FBI investigation and the criteria by which decisions are to be made by the Atomic Energy Commission.
6. Our special misgivings about FBI investigation and Atomic Energy Commission clearance do not apply to candidates for secret work.

October 26, 1949

Letter dated November 17 from Carroll L. Wilson, general manager of the U. S. Atomic Energy Commission, to Alfred N. Richards, president of the National Academy of Sciences:

We have considered your letter of November 2, 1949, and its attached statement prepared by the Council of the National Academy of Sciences. We understand that the Academy does not believe that the National Research Council should accept the responsibility for administering the Atomic Energy Commission fellowship program as altered by the amendment to the Independent Offices Appropriation Act of 1950. We regret that the restrictions imposed by the fellowship rider have made it necessary for the National Academy of Sciences to come to that conclusion. We feel, and we know you must also feel, that fairness to prospective fellowship applicants demands a statement in the near future of the status of the fellowship program. We are therefore writing to inquire if it would be acceptable to the National Academy of Sciences to have the National Research Council administer a fellowship program limited, during the period the restrictions of the amendment apply, by the conditions listed below.

1. No new appointments are to be made to predoctoral fellowships, except possibly for a small number of fellowships in secret fields.

2. The present broad program of postdoctoral fellowships is to be limited to those candidates whose proposed research is such that, in the opinion of the Commission, a high probability exists of subsequent employment requiring access to secret data. Fellows would not be obligated, however, to accept subsequent employment by the Commission or one of its contractors. We would expect this limitation to confine postdoctoral fellowships in the physical sciences to fewer fields than are now open. The present program of postdoctoral fellowships in the bio-

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Growth Failure in School Children as Associated with Vitamin B₁₂ Deficiency—Response to Oral Therapy

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DESPITE ITS ORIGINAL PROPERTY as a growth-promoting agent for certain bacteria (4) and subsequent evidence that it stimulates animal growth (1, 2), studies of vitamin B₁₂ in man have been confined to its hemato-

poietic, clinical, and neurological effects in disease—viz., pernicious anemia and sprue. Information on its more general nutritional value has thus far had to come from animal work, in which growth could be experimentally held in check as desired, through purified diets, and thus through deprivation of B₁₂ or of other food constituents, with or without caloric restric-

¹With the technical assistance of Dr. Francis Bayless, Edna Chapman, and Barney Tautkins.

tion. Since deliberate depletion in children is excluded, the growth effects of B_{12} must be studied under constraints which parallel those in anemia, in the sense that results must be appraised, not under normal blood or growth conditions, but in states of hematopathology and of growth failure, respectively. In the case of growth disturbance, however, the constraints are even more rigid, for, although it is permissible to follow B_{12} hematopoiesis in "untreated" or in "recently untreated" patients—that is, essentially under initial conditions of depletion—it happens that any one of a number of nonspecific agents, even mere environmental change, can set recovery from growth failure in motion. What this means is that a growth stimulus attributable to vitamin B_{12} must be demonstrated in the face of whatever recovery had already set in, and hence by potentiation of such prior effects, which had themselves, moreover, been sufficiently stable to be taking place under a condition of statistical control. Technically, the problem is one of "improving an improvement" and of measuring both.

Certain other aspects should be considered in order to clarify interpretations. Onset of simple growth failure in school age children, as evaluated by the Grid technique (5), is characterized by quite specific deviations beyond known tolerance values for two chief parameters, the *direction* (Fig. 1-A) and the *speed* of physical development (B), with associated deviations in body *size* (level) and *shape* (physique channel) and with the consequent accumulation of corresponding calorie "fuel debts" (6). Recovery, on the other hand, is measured by reversal of such trends and, in particular, by the extent to which physique is restored, lag made up, and fuel debt repaid.

For practical purposes, the chief tolerance values in healthy growth may be taken as follows: no child should lose more than $\frac{1}{2}$ channel of physique in 10 levels of advancement and it should not fail by more than 2 or 3 levels to attain its expected year-end level position if it is to develop at the normal rate of 1 level per month or 12 levels per year. These parameters and tolerances, it may be emphasized, are independent of race, sex, weight, height, size, shape, and—up to maturation—of age.

As a rule, recovery from and treatment of simple growth failure in school children, whether mild, moderate, or severe as regards physique loss, level lag, or calorie debt, is readily achieved through systematic programming designed to meet individual needs (6). Some of the prominent elements of such programs are good hygiene, balance between exercise and rest, planned calorie conservation, and emotional calm, all aimed at restoring physique to par, and eliminating lag and fuel debts. The affliction is peculiarly ame-

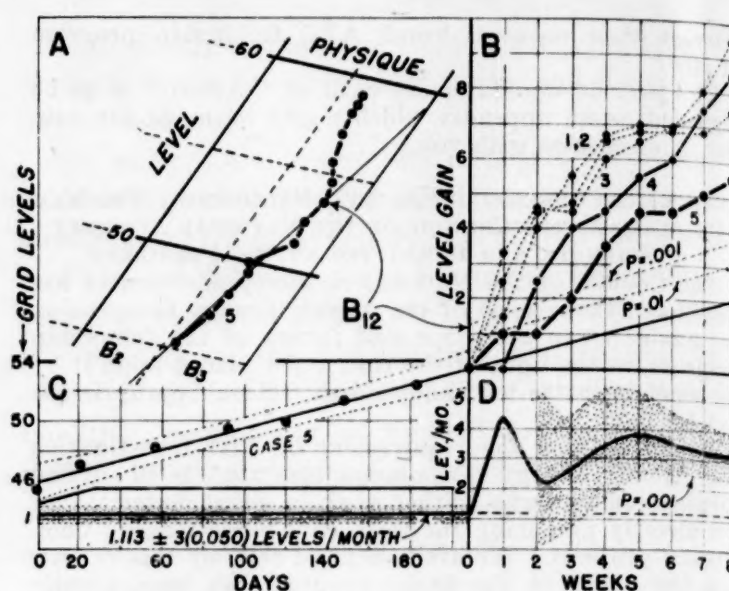


FIG. 1. Growth responses to oral vitamin B_{12} . A—Directional shift with increasing physique in Case 5. B—Level gains in five reactors with confidence bands for No. 5. C—The previous 208-day regression of Grid level on time with its 0.001 confidence band; data show existence of Shewhart (3) state of control. Lower C—Rate of development for No. 5, with standard error and error band. D—Velocity surge in No. 5 following administration of B_{12} and the 0.001 confidence band.

nable to group or institutional management when individual personality problems can be worked out. Obviously, diets must supply all daily needs including overages to cover fuel debts (6); composition approximates carbohydrates 50 percent, fats 35 percent, and proteins 15 percent. On occasion, vitamin supplements are required. Nutrition is clearly to be emphasized because it is always involved in recovery, regardless of the main or inciting cause or causes that led to growth failure.

We have repeatedly observed beneficial effects from vitamin supplements or from oral administration of whole liver extract² which are specially prescribed when progress has been delayed out of proportion to physical or other findings. On the other hand, we have been impressed with unaccountably slow progress in spite of intensive effort to seek out causes and to establish more satisfactory recovery rates. At such times, the possibility of unknown and otherwise unheralded deficiencies has naturally suggested itself.

In August 1949 we began to administer 10 μ g of crystalline vitamin B_{12} orally³ to 11 children (6 boys, 5 girls; ages 5–12 years) 3 of whom (Nos. 2, 4, 5 of Fig. 1) were selected on account of slow progress, the remaining 8 at random from a group of 76 under regular care for varying degrees of malnutrition and in varying states of recovery from simple growth

² First suggested to us by Paul György in 1941.

³ Crystalline vitamin B_{12} (Coblone[®]) was kindly supplied by the Medical Division of Merck & Company, Inc. of Rahway, New Jersey.

failure. Oral administration of the same dose was continued daily at the time of the usual midmorning milk offering. Heights and weights (clothes off) were

TABLE 1
RATES OF DEVELOPMENT, STANDARD ERRORS, ETC.

Case No.	Levels per month			Degrees of freedom	t	p <
	Before	After	Difference*			
1	2.50 ± 0.40	5.30 ± 0.42	2.80 ± 0.56	9	5.00	0.001
2	0.65 ± 0.12	3.40 ± 0.66	2.74 ± 0.63	15	4.35	0.001
3	0.65 ± 0.38	4.52 ± 0.60	3.87 ± 0.68	7	5.66	0.001
4	1.89 ± 0.62	4.71 ± 0.31	2.81 ± 0.69	10	4.09	0.01
5	1.113 ± 0.050	3.18 ± 0.25	2.06 ± 0.23	13	8.96	0.001
65 Controls	2.27 ± 0.13	.....	.....	317	.....	.....
6 Non-reactors	1.86 ± 0.12	2.00 ± 0.70	0.00	.....	.....	.....

* Errors of differences computed from pooled variances.

remeasured weekly at the same hour. All other program elements were strictly maintained as before on an individual basis. A child, for example, who had been getting extra rest, or another who had been receiving whole liver extract, continued to do so.

Five of the original 11 subjects responded dramatically to this single change in routine represented by the administration of B₁₂, the effects being objectively measured by physique and level gains as charted on each child's Grid record and, for utmost accuracy, as calculated from the corresponding equations for physique, P, and level of development, D (5). Before and after values of regression coefficients, standard errors thereof, and confidence bands for values of p = 0.01 and 0.001 were likewise computed, with due allowance for degrees of freedom available from the number of previous observations. Untreated resident children were a time-place-season control group.

Results summarized in Table 1 and in Fig. 1-B show that 4 of the 5 reactors achieved an average gain of more than 8 levels in 8 weeks, and thus somewhat more than the response of Case 5 who, though gaining only 5½ levels in the same interval, nevertheless exceeded her own 8th week expectancy (as estimated from the extension [B] of the regression [C]) by 3.6 levels, so that t = 12.3 and p is considerably less than 0.001 for the 6 degrees of freedom contributed by the previous 208-day control period in C. The response of Case 5 is further defined in Fig. 1-A, -C, and -D. In particular, her course of development in 1-A, which had

been deviating by more than ½ channel per 10 levels advance, shifted promptly in the direction of increasing physique; in upper 1-C are the linear regression of level on age (time) and the confidence bands for p = 0.001; in lower 1-C, the corresponding constant rate of development, 1.113 ± 0.050 levels per month, with its associated error band of 3σ_b. The statistical evidence of 1-C illustrates the attainment of Shewhart (3) conditions of control prior to administration of vitamin B₁₂. Finally, in section Fig. 1-D is shown the pulseline surge in the speed of development corresponding to the level gains of Case 5 in 1-B, along with the 0.001 confidence band based on the degrees of freedom available at successive weekly observations. From Fig. 1-B and -D the effect of B₁₂ had become statistically significant at the p = 0.01 level by the end of the third week, and at the p = 0.001 value by the fourth week.

Clinical examinations prior to B₁₂ ingestion revealed no characteristic or even suggestive regional signs in hair, skin, eyes, mouth, or nervous system. The only noticeable clinical changes after B₁₂ administration were those of increased physical vigor, alertness, better general behavior, but above all, a definite increase in appetite, manifested by demands for "second helpings," as contrasted with comparatively indolent food habits before. Moderate eosinophilia (6-8 percent) and reticulocytosis (0.6-0.9 percent) were found in 9 of the 11 subjects.

The most dramatic general effects were shown by Case 2, a boy with severe allergic bronchitis, whose sleep for 12 months before had been regularly interrupted by asthmatic attacks and whose daytime wheezing permitted little desire for food, not to mention time for eating it. His growth response was accompanied by a remarkable attenuation of symptoms; in fact, these simply vanished during the first week, to the surprise of every attendant, lay or professional. What possible connections there may be between B₁₂, its influence on protein metabolism, and allergic disturbance, are questions for further investigation.

Taken together, the foregoing results speak, and they speak with measurable statistical certainty, of what may be termed B₁₂ functional deficiency, that was definitely benefited by oral therapy. As a final measure of effects it may be remarked that the growth responses were equivalent to another 100-240 days of regular institutional care without the help of B₁₂.

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Technical Papers

Atom Bomb Cataracts¹

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At the suggestion of the Committee on Ophthalmology of the National Research Council, a survey has been undertaken to determine what, if any, late ocular effects have resulted from the atom bombings in Japan. The undertaking was prompted in considerable measure by the recent discovery of cataracts in cyclotron workers. The survey is being currently carried out under the auspices of the Atomic Bomb Casualty Commission, and the present communication is a preliminary report on ten cases of cataracts which are believed to have been caused by the atomic bombs.

Nine of the patients were exposed at Hiroshima and one of the patients at Nagasaki. All were said to have had normal visual acuity prior to the bombing and for some time afterward. Seven were males and three were females. The ages at the time of the exposure were 13 to 55 years. All were within 550 to 950 meters of the hypocenter at the time of the explosion. Three were standing in the forward part of a streetcar next to each other, four were in wooden houses roofed with tile, one was crouching behind a wooden building, one was walking in the street, shielded by the plaster wall of a building, and one is not known to have had any shielding. Two had thermal burns of the profile type (that is, due to radiant heat); all had epilation of the head after a latent period of one to four weeks, with complete baldness lasting three to seven months. Six vomited on the day of the explosion, and eight had symptoms one to three weeks after the explosion consisting of fever and malaise, with vomiting and diarrhea in five and petechiae in five. One developed a sloughing lesion of the buccal mucosa and another a localized necrosis of the cheek with perforation. Whether these were due to radiation sickness or to the insanitary conditions prevailing at the time could not be determined. One of the three female patients has had amenorrhea since the exposure and the other two began their menses at ages 17 and 19, approximately three years after the exposure.

The only ocular complaint of the patients was failing vision. In one patient, the onset of subjective visual symptoms was said to have been as early as one month after the bombing, but the patient was in an apprehensive mental state at the time and it is by no means certain

that this initial complaint was owing to incipient cataracts. The latent period of visual symptoms was 6 months in one patient, 2½ years in one patient, and 2½ years in four patients. Three patients had no ocular complaints. The failure of vision was said to have been either gradual or stepwise and fluctuant in the seven patients, one of these patients having thought some improvement followed each loss. Three of the patients had been seen by Japanese ophthalmologists and recognized as having cataracts due to radiation: two by H. Ikui and one by K. Hirose.

The cataracts consisted of opacities in the axial zone of the posterior lenticular capsules over an area of 2 to 4 mm, with occasional punctate dots farther toward the periphery. The findings were approximately symmetrical in the two eyes. The central opaque disks had jagged but nevertheless relatively sharp edges. In the five patients in whom the changes were most marked, the peripheral portions of the opaque disks were denser than the central portions, forming doughnut-shaped opacities when examined with the ophthalmoscope. With the slit-lamp biomicroscope the opacities were of a lace-like texture, having a few polychromatic crystals and a few vacuoles. The opacities were confined to the posterior capsules, with no apparent extension into the underlying cortex, but the vacuoles were situated just in front of the capsules. In the two most advanced cases there was a distinct separation of the opacity centrally into two laminae from front to back, with a relatively clear interval between them. Toward the periphery of this central disk the two laminae fused to form the denser ring that had given rise to the doughnut-shaped opacities seen with the ophthalmoscope. In the less advanced cases, which did not show the doughnut configuration, the central portion showed an opacification of the whole thickness of the posterior capsule similar to the peripheral portion of the disk in the more advanced cases. Thus it appears that progression of these cataracts is accompanied by a separation of the central opacity by a clear interval and an extension of the unsplit opacity toward the periphery. The anterior capsule also showed a few punctate dots in seven of the patients and an occasional vacuole in three. The lens cortex and nucleus, however, was entirely clear in all cases.

The cataracts are considered to be similar to those which have previously been associated with exposure to x-rays and gamma rays (1). What part neutrons played in their pathogenesis is not evident. The patients were in a zone where neutrons and gamma rays were present, although information on the amounts of each is not accurately available. Most persons in this zone died either from thermal or mechanical injuries or from radiation sickness. That these persons survived and developed cataracts may be attributed simply to biologic variations; but it cannot be reasonably denied that

¹ This work was sponsored by the Atomic Bomb Casualty Commission, National Research Council, with funds supplied by the U. S. Atomic Energy Commission.

whereas the cataracts resulted from exposure of the head region, the absence of lethal radiation disease may have been owing to a shielding of much of the rest of the body. Five of the patients had very little, if any, radiation sickness, and the symptoms in the others may not have been caused by the radiation. Yet all of them had profound epilation of the head, which was undoubtedly a radiation effect. It is possible that the three standing in front of the streetcar were protected in the lower halves of their bodies by the metallic baseboard below the car windows.

The frequency of atom bomb cataracts now, or to be expected in the future, cannot be stated at present, since practically all the cases of cataracts here cited were discovered through highly selective methods. However, it may be noteworthy that 1000 persons, believed to be a cross section of the survivors, who were within two kilometers of the hypocenter and in the open (including 16 persons within one kilometer), were examined and no case of radiation cataract was found. (Although all these persons were out of doors at the time of the explosion, the amount of shielding by buildings, posts, other persons, etc. could not be satisfactorily determined.) Among an additional 231 persons within one kilometer of the hypocenter, who were either in the open or in wooden buildings at the time of the explosion, there were found five cases of radiation cataracts (included in the ten mentioned above).

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Cyclotron-induced Radiation Cataracts

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Although it is impossible now to make a complete or final report on the cyclotron-produced radiation cataracts, it seems desirable to publish a preliminary survey of the situation as it now appears. This survey should serve as another warning to research personnel and administrators in the field of high energy particles and it also should serve to indicate how large is the area of ignorance regarding radiation effects on higher organisms.

Early in December 1948 it became known that at least five nuclear physicists of average age 31 were afflicted with incipient cataracts. An *ad hoc* committee set up by the Division of Medical Sciences of the National Research Council arranged for questionnaires to be sent to all the high voltage laboratories of the country where comparable exposure risks might have been incurred, and a considerable body of preliminary data became available by this means.

Arrangements were made to bring together as many as possible of the afflicted men, along with a few other especially qualified and interested individuals, to discover

and compare if possible the common denominators of their experience and to make careful comparable medical examinations. A meeting was held in Washington, D. C., January 16 and 17, 1949, under the auspices of the Division of Medical Sciences, National Research Council, with the support of the U. S. Atomic Energy Commission. On January 18, eleven of these men were examined at the Wilmer Ophthalmological Institute, Johns Hopkins School of Medicine, by Drs. Alan Woods, Jonas Friedenwald, and Algernon Reese, who concurred in the following findings:

1. Ten of these patients showed opacities in the lenses.
2. The patients fell into three general groups as follows:

Group A (3 men): All showed severe changes in the posterior cortex of the lens, consisting of thick saucer or disk-like opacities, together with slight subcapsular or anterior cortical haze. The capsule and nucleus of the lens were clear, and there was no other pathology found in these eyes (except postoperative changes in one individual). In all vision was reduced.

Group B (4 men): Slight to moderate changes in the posterior cortex of the lens. These changes consisted in whitish opacities with a definite tendency to saucer or disk-like formation, in the milder cases accompanied by a golden reflex and occasionally by slight iridescence. Again there was occasionally slight haze in the anterior cortex, and a few vacuoles. The media and capsules were clear, and there was no other pathology in the eyes. In these men, vision was either normal or only slightly reduced.

Group C (3 men): Minimal, insignificant, and doubtfully relevant changes. The findings consisted in a thin lacy opacity in the posterior cortex and occasional punctate dots, and capsular iridescence. The thin lacy opacity, when observed, lay in the posterior cortex with a suggestion of disk formation, which made it a little suspicious. There was, however, considerable doubt in the minds of all three examiners whether these slight changes were definitely pathological. There were no other changes observed in these eyes.

3. All the observed changes followed the same general pattern, showing different degrees of severity. Furthermore, this common picture conforms to the general picture of roentgen-ray and radium cataracts. In the absence of other recognized causes, and with the common denominator of exposure to cyclotron irradiation, it appears logical to attribute these lens opacities to this cause.

Table 1 summarizes the experience of these men.

The men are listed in the table in the order of severity of symptoms. The first three men have what can be termed a severe handicap. The next four are afflicted to a degree which does not at present interfere markedly with daily life. The remaining three have a minimal affliction which does not cause appreciable handicap. It was noted, however, that the severe cases did not fully develop until about three years after the radiation was received. Hence, some of the men may in the future show a more severe pathological condition arising from radiation already received. Since there has been no evidence of damage to the retina, it would appear that there is a good prognosis for successful surgical intervention in the severe cases. Indeed, in the interval between January and July 1949, cataracts were successfully removed from two of the individuals concerned. Thus, it

TABLE 1

Patient	Probable date of exposure	Estimated total exposure to neutrons (n-units)	Duration of exposure in weeks	Visual acuity			
				Uncorrected		Corrected	
				Left	Right	Left	Right
1	1944	135*	200	LP†	...	LP†	20/200
2	1943-44	80	25	...	...	20/100	5/200
3	1943-44	80	25	20/100+2	20/70-1	20/20/3	20/40-2
4	1941-47	30-40	250	20/40	20/20-1	20/20-1	20/20
5	1947-48	30-100	10	20/40	20/70	20/15	20/15
6	1947-48	20-100	30	20/40	20/30	20/20	20/20
7	1943-44	10	25	20/20	20/50	20/20	20/15
8	1939-42	70	100	20/20-4	20/20-3	20/15-1	20/15
9	1947-48	4-25	10	20/70	20/20	20/40	20/15
10	1938-40	15	80	20/20	20/20	20/15	20/15

* Patient 1 had one acute exposure of 35 n.

† LP = Light projection only.

appears that the afflicted men will not lose their vision irretrievably. All of the men involved are in reasonably good spirits and are carrying on productive activities professionally.

The accurate measurement of neutron intensities and energies is a rather difficult problem. To date most measurements have been made using equipment originally designed for use with x-rays. When a 100-r Victoreen chamber is exposed to fast neutrons and a full-scale reading is obtained, the instrument is said to indicate an exposure of 100 n. In many experiments it is convenient to use a 25-r Victoreen chamber and the resulting dose is expressed in N-units. In general, tissue dose in roentgen equivalent physical equals 1.5 n equals 2 N.

It is difficult today to estimate exposure occurring three to nine years ago. The individuals involved made independent calculations of their own exposures. The cumulative doses estimated were surprisingly low with a median dose 50 n.

At the time these men were receiving the exposure that led to cataracts, most were being given periodic blood examinations. In no case was there a change in blood picture to give a dramatic warning of overexposure to radiation. In only two cases was there a mild epilation. In general neutron irradiation of the head was greater than that to the whole body. Perhaps this accounts for the failure to observe blood changes.

It seems probable that the causative agent of the injury in most cases was chronic exposure to neutrons in the range 0-20 Mev. Evidence for this statement is rather indirect. The high energy radiation from the cyclotrons involved is principally neutrons and gamma rays. In most cases, the intensity as measured in an ionization chamber shows slightly more neutron than gamma-ray effect. Since not nearly enough gamma-ray intensity is present to produce cataracts, elimination leaves neutrons. The possibility does exist that the neutron effect might be enhanced by radiofrequency effects or by motion in the magnetic field of the cyclotron. However, the discovery of cataract production in mice by both cyclotron- and nuclear reactor-produced neutrons seems to make such complicating suggestions unnecessary.

In most cases, persons involved received their neutron exposure while at an angle of about 90° to the direction of a 8-to-16 Mev deuteron or proton beam. Target materials were variable and few measurements have been made by nuclear physicists of the particles emitted when particles of this energy strike targets of any kind. In most cases, there was little moderating material between the source and the lens.

A survey of the literature with respect to radiation cataracts reveals that considerable qualitative but little quantitative information is extant regarding cataracts induced by x-rays and gamma rays. Leinfelder and Kerr (2) have published one of the best studies of roentgen-ray cataract in humans. While their data involve a small number of cases, the indication is that approximately 2500 r is required to produce the effect. From supplementary studies on rabbits they found soft x-rays to be more damaging than hard x-rays, and that small doses of x-rays given over a period of time were less injurious than an equal acute dose.

Very little is known regarding cataracts produced by neutrons. The paper of T. C. Evans (1) provides the best information and indicates that the biological effectiveness of chronic doses of neutrons in producing lens abnormalities in mice may be as high as 8-40 times as great as x-rays. Insofar as the data from human eyes can be interpreted, it seems likely that with chronic exposure, the ratio of rem to rep for neutrons may likewise be as high as 10-40; that is, the ratio of roentgen equivalent man to roentgen equivalent physical may be as high as 10-40. Results given by R. S. Stone (3) are in accord with high biological effectiveness of chronic neutron exposure.

It should be emphasized that these figures for biological effectiveness of neutrons are merely the best estimates that incomplete and fragmentary data permit. In view of the implications of this finding, it is extremely important that further and more quantitative information be gathered from both animals and man.

It appears probable that if complete examination were made of all persons who have worked with cyclotrons, a further small group of afflicted individuals might be discovered. Most of the additional cases would probably

be found not to be markedly handicapped. It is also possible that other portions of the body may be relatively highly affected by neutrons. For instance, the Evans experiments suggest, in mice, a selective sensitivity of the gonads as well as of the lens.

It is perhaps worth while to list a few of the areas of ignorance which have been highlighted by this unfortunate episode:

1. The exact causative agent is not definitely known;
2. The dose is imperfectly known;
3. Almost no systematic neutron research has yet been performed on organisms larger than a mouse;
4. There is little knowledge extant of what other organs of the animal may be especially susceptible to damage under special circumstances;
5. The concept of the rem (roentgen equivalent man) for neutrons and indeed for other new types of radiation is probably of limited value, since the conversion factor varies with tissue.

The National Research Council has appointed a Committee on Radiation Cataracts which is collecting additional information regarding others who have been exposed to neutrons. The committee will also conduct follow-up studies of those already known to be injured. Communications should be addressed to Philip S. Owen, M.D., Executive Secretary, Committee on Radiation Cataracts, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C.

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Sodium 2-Methyl-4-Dimethylaminophenylphosphinite, a Probable Methyl Donor^{1,2}

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Previous investigations on biological methyl donors have shown evidence of a rather limited number of substances exhibiting donating properties, most of them being N-methyl compounds like choline. It is interesting to note that such N-methyl compounds, having the ability of giving methyl groups intact, show a similar basic structure—namely, they have their labile methyl groups bound with a quaternary or positive nitrogen (choline, betaine, dimethylethyl- β -hydroxyethylammonium

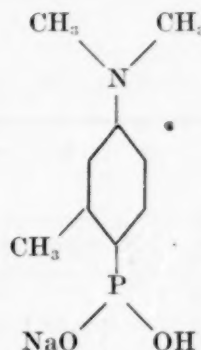
¹ We are greatly indebted to Mr. Cesare Barbieri and to the American Committee, University of Bologna, New York, for donation of the Beckman DU Spectrophotometer used in this investigation.

² The experiments have been performed with sodium 2-methyl-4-dimethylaminophenylphosphinite supplied by Consorzio Neoterapico Nazionale, Roma.

chloride [6], tetramethylammonium formate, methyltriethanolammonium iodide [2], etc. These observations fit in with the theory described by Du Vigneaud (3) based on the different ability of transmethylation shown by partially methylated aminoethanols and choline.

The relationship existing between structure and methylation capacity, described in the N-compounds cited, appears worthy of being generalized (2). Ciusa claims also that methyl compounds of arsenic, selenium, oxygen, and sulphur (2) may act as methyl donors when methyl groups are bound with electropositive atoms. A confirmation of this is obtained by experimental investigations on sodium cacodylate, and particularly in recent studies by Du Vigneaud on dimethylpropiothetin (4) and dimethylthetin (5).

A few recent observations from this laboratory concerning sodium 2-methyl-4-dimethylaminophenylphosphinite, which is used largely in therapy, are not in agreement with these assumptions.



The administration of this substance to human subjects, in normal conditions, causes a remarkable rise in urine elimination of N₁-methylnicotinamide, a product of the irreversible methylation of nicotinamide, introduced with diet and chosen as a test of the methylation activity (2).

We do not intend to take into consideration here details of technique, which are to be published later; we are reporting, instead, a few data obtained in this investigation, pointing out that the experiments have been performed on ourselves and on laboratory personnel, fed a rigorously standard diet, under normal conditions.

The values of N-methylnicotinamide reported herein refer to 24-hr urines. The administration of sodium 2-methyl-4-dimethylaminophenylphosphinite in a single therapeutic dose (30 mg), causes an immediate urinary increase in N₁-methylnicotinamide as seen in results in Fig. 1. The increase, in this case, is approximately 60%, while in other human subjects it has reached even higher values.

When the administration of the substance under observation is continued for several days in even small doses (15 mg), the elimination of N₁ is maintained constantly elevated above the normal, returning to the initial values as soon as the treatment is terminated. We do not believe the action of sodium 2-methyl-4-dimethylaminophenylphosphinite is attributable to a simple activation of methylation processes. The increased elimination, in fact, remains even when the subject is preventively treated and also treated during the experiment

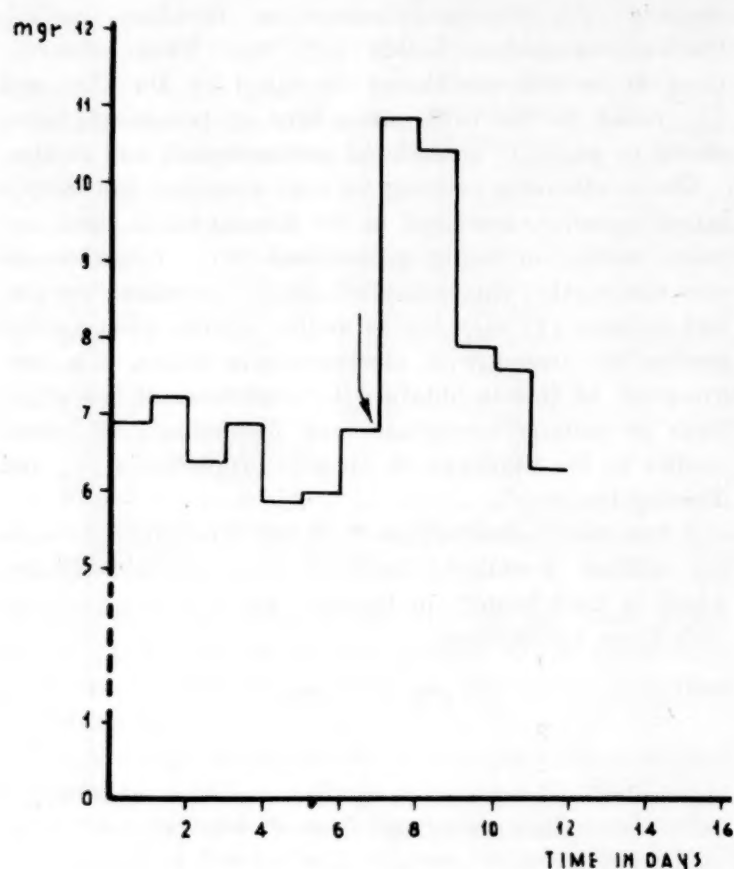


FIG. 1. Elimination of N_1 with urine. Arrow indicates the administration of 30 mg of sodium 2-methyl-4-dimethylaminophenylphosphinite.

with B_{12} , which regulates the elimination of urinary N_1 , due to a probable catalytic action, carrying it to an almost constant level. These observations lead us, there-

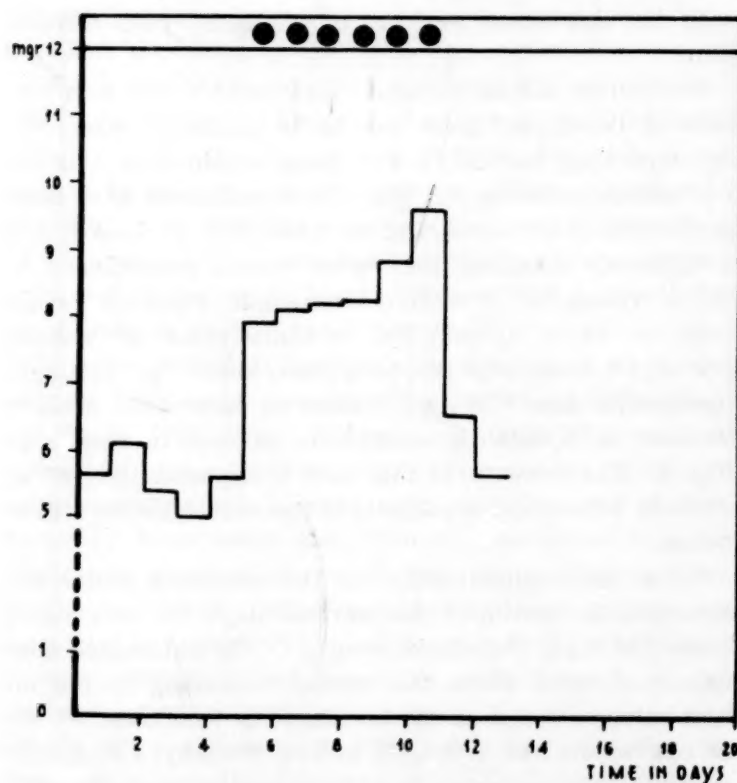
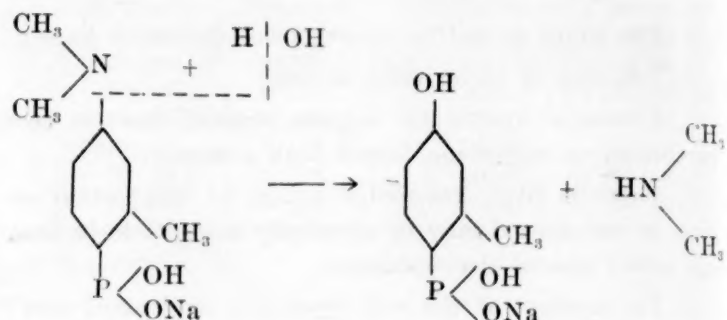


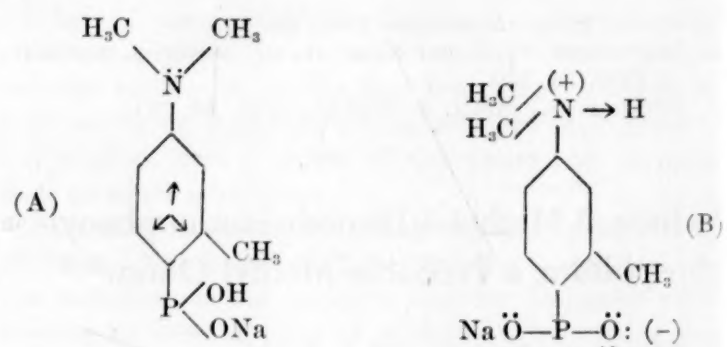
FIG. 2. Elimination of N_1 with urine after continuous treatment with sodium 2-methyl-4-dimethylaminophenylphosphinite. Each • indicates the administration of 15 mg.

fore, to believe that sodium 2-methyl-4-dimethylaminophenylphosphinite acts as a methyl donor.

The interpretation of the mechanism which might explain this action is hypothetical. Analogously, along with *p*-nitrous dimethylaniline, we assume that also sodium 2-methyl-4-dimethylaminophenylphosphinite may yield dimethylamine as shown in the following:



The reaction may be enhanced by the presence of a methyl group in position 2 of the benzene ring which, being similarly oriented with other substitutes according to the Bonino (1) symbolism, (A) affords more mobility to the substitute in position 4. We do not believe, however, that dimethylamine is a methyl donor, noting that dimethylaminoethanol is a methyl acceptor rather than a methyl donor. It appears, instead, more probable that the methylation action of sodium 2-methyl-4-dimethylaminophenylphosphinite is attributable to a dipolar form (B):



in which is shown a positive nitrogen of N_1 -methylated compounds acting as a methyl donor.

Our observations are in accord with the hypothesis cited (2, 3), and make evident a probably new methylating agent, the importance of which lies in its wide therapeutic use. These observations show also the interest which may derive from a structural study of substances of this type.

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Application of Perchloric Acid Technique to Protozoa

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In making a study of the cytochemistry of the ciliate protozoon, *Chilodonella uncinatus*, with the more familiar tests for nucleic acids and proteins, the perchloric acid technique recently developed by Ogur and Rosen (2) is of considerable interest. They have reported the extraction of nucleic acids from certain plant tissues with the use of perchloric acid. Their data indicate that prolonged contact in the cold with perchloric acid extracts pentose nucleic acid (PNA) but not desoxypentose nucleic acid (DNA); while at elevated temperatures, both of these are extracted from the homogenates. This leads them to conclude that cold perchloric acid appears comparable to ribonuclease. Their technique was adapted by us to slide analysis and was applied to *Chilodonella* in this manner:

The organisms were fixed in bulk in acetic acid-alcohol (one part acetic acid to three parts 95% alcohol). This fixative is particularly useful in that it also extracts the inorganic phosphates and does not interfere with any subsequent tests by the deposition of heavy metals. The organisms were affixed to albumin-smear slides in the usual manner. After hydration the slides were processed in 2%, 5%, and 10% perchloric acid concentrations at various temperatures and for different lengths of time. After adequate washings they were stained with Feulgen (4), Unna-Pappenheim mixture, methyl green (3), and toluidine blue. Adequate controls were maintained by processing duplicate slides under the same conditions but without added perchloric acid. The results noted are based upon visual judgments using the compound microscope.

Results of the various treatments are as follows:

In any treatment, 2% or 10% perchloric acid, in the cold or at higher temperatures, the clearing of cytoplasmic basophilia in toluidine blue preparations and the lack of pyronin staining in Unna-Pappenheim mixture would seem to indicate that PNA is removed from the cytoplasm. The extent of PNA extraction in 2% perchloric acid in the cold depends, however, on the length of contact (see Table 1).

Two percent perchloric acid used in the cold, although apparently having no effect on the Feulgen reaction and thus on DNA, would appear to depolymerize this nucleic acid progressively, as shown by the decrease in methyl green staining capacity. Such structures of the nuclear apparatus that fail to stain with methyl green are stained with pyronin in Unna-Pappenheim mixture. According to Kurnick (1), such a reaction indicates the presence of a lower polymer, as pyronin stains only PNA and depolymerized DNA.

Ten percent perchloric acid at 5° C removes PNA very rapidly. In addition, our preparations of *Chilodonella* show that prolonged contact with the acid decreases the

¹ We wish to express our thanks to Dr. D. H. Wenrich for his interest and criticism.

TABLE 1
DETAILS OF TREATMENT WITH PERCHLORIC ACID ON
Chilodonella uncinatus

% HClO ₄	Temp (C)	Time (hr)	Results	
			cytoplasm	nucleus
2	5°	3, 10, 18, 24, 72	Progressively decreased basophilia, beginning at about 10 hr.	Feulgen reaction remains unchanged. Methyl green intensity decreases progressively starting at about 18 hr.
10	5°	3, 10, 18, 24, 72	No basophilia.	Feulgen intensity progressively decreases. Methyl green staining becomes less intense, until at 72 hr it is practically nil.
5-10	35°	18	No basophilia.	Feulgen as well as methyl green staining are very faint.
5-10	70°	20 min	No basophilia.	Feulgen and methyl green reactions are negative.

Feulgen staining capacity of the nuclear apparatus. It would seem that DNA is also being extracted. The methyl green preparations are even more striking; at 72 hr the reaction is essentially negative.

Five percent or 10% perchloric acid at temperatures of 35° C and above is capable of extracting DNA quite rapidly, total extraction occurring at 75° C where, within 20 min, the nuclear apparatus becomes Feulgen negative and the cytoplasm shows essentially no basophilia. However, hot water treatment of the animals reduces the staining intensity with the specific stains, Feulgen and methyl green. In particular, the methyl green reaction becomes rapidly negative. It is thus extremely important to carry adequate controls before interpreting results.

It seems possible that in *Chilodonella*, cold perchloric acid on prolonged application is able, in addition to extracting PNA, to depolymerize DNA. This depolymerization might be an essential preliminary step in the process of extraction of this nucleic acid. The extraction appears to take place to a considerable extent in 10% perchloric acid in the cold, indicating that rather rigid conditions may be necessary before a parallel between the actions of perchloric acid and ribonuclease can be established. It may be noted, however, that the nuclear apparatus of *Chilodonella* is unique in many respects, and the reactions that one finds here may not necessarily be applicable to other animal cells or even to other protozoa.

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The Use of Triphenyltetrazolium Chloride for the Study of Respiration of Tissue Slices

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In 1948 Strauss, Cheronis and Straus suggested the use of triphenyltetrazolium chloride for the differentiation of cancer tissue from surrounding normal tissue. The authors indicated that tumor tissue would reduce the dye more readily than normal tissues (2). The use of triphenyltetrazolium chloride was also mentioned by Kun and Abood (1) in a study of the respiration of tissue homogenates. Our paper will describe a technique whereby the respiration of tissue slices may be measured with the aid of 2,3,5-triphenyltetrazolium chloride, and will present some results of these measurements.

The tissues which were studied include liver, kidney, spleen, diaphragm, small intestine, and spontaneous mammary carcinoma, all from CFW mice. With the exception of the diaphragm, tissues are sliced freehand, at a thickness of approximately 0.5 mm. The diaphragm was not sectioned, since it is thin enough to permit ready diffusion. All sections were run in duplicate so that reproducibility of the results could be evaluated.

The animal was usually killed rapidly by crushing the cervical cord, and sections of the organs were made within

TABLE 1
REDUCTION OF TETRAZOLIUM BY DUPLICATED TISSUE SLICES (30-MIN INCUBATION)

Tissue	Colorimeter reading	Tissue weight in mg	Reading per mg
Liver, a	131	3.1	42.2
Liver, b	140	3.1	45.1
Kidney, a	88	1.6	55.0
Kidney, b	226	3.7	61.0
Tumor, a	120	6.7	17.8
Tumor, b	146	7.3	20.0

a few minutes of death. The tissue sections were placed in wide-mouthed test tubes (1.5 x 10 cm) and 5 ml of normal saline was added to remove blood and extraneous material. The solution was then decanted and 3 ml of the buffered (pH 7.2) 1% tetrazolium solution in distilled water was added. The tubes, placed in a rack in an incubator maintained at 37° C, were agitated gently by means of a mechanical shaker. After incubation the tubes were removed, the tetrazolium solution was decanted, and the red color of the reduced tetrazolium extracted with acetone. The extraction was a quantitative one accomplished by means of repeated washings with acetone. Each washing was added to a Klett colorimeter tube. Usually four washings of 2 ml, 1 ml, ½ ml, and ½ ml were sufficient to remove all the color from the tissue. The acetone in each colorimeter tube was then diluted to the 5-ml mark with additional acetone, and after

thorough mixing, the intensity of the color was read in a Klett-Summerson photoelectric colorimeter, using the green No. 42 filter. The tissues were allowed to dry at room temperature, a procedure which was accomplished rapidly because of the previous acetone dehydration. The tissues were then weighed on an analytical balance and the color reading determined per mg of tissue. The color readings can also be converted to gamma of tetrazolium reduced, by the use of a standard dilution curve of reduced tetrazolium as indicated by Kun and Abood.

The values obtained by this technique were reproducible in duplicate slices as shown in Table 1. The mean values as well as the spread of values for the endogenous metabolism of the various tissues of CFW mice, with and without spontaneous mammary carcinoma, are shown in Table 2.

It will be noted that the values obtained are similar in tissues from animals with and without spontaneous breast carcinoma. The only apparent exception to this is in the case of the diaphragm after 30-min incubation,

TABLE 2
COLORIMETRIC ESTIMATION OF REDUCTION OF
TRIPHENYLTETRAZOLIUM CHLORIDE
BY TISSUE SLICES

Organ	Female CFW mice with spontaneous mammary carcinoma 30-min. incubation				60-min incubation			
	No. animals	Lowest value	Highest value	Mean	No. cases	Lowest value	Highest value	Mean
Liver	10	33	53	40	7	47	82	65
Kidney	10	41	63	55	5	79	112	99
Diaphragm	5	19	43	33	4	20	37	29
Small intestine	2	43	50	46	4	39	76	56
Tumor	7	7	33	17	4	18	24	22
Spleen	4	11	41	22	13	8	32	18
Male and female CFW mice without tumor								
Liver	6	34	52	41	17	53	93	63
Kidney	6	44	71	52	12	83	141	91
Diaphragm	5	24	76	52	5	20	36	29
Small intestine	4	26	55	41	4	39	77	56
Spleen	2	9	18	15	7	10	32	16

where the mean value obtained was lower in the presence of the tumor. However, after a 60-min incubation period the mean values were identical. The relative intensity of the endogenous metabolism as measured by this technique (with 1-hr incubation) is in the following order: kidney, liver, duodenum, diaphragm, tumor, spleen. It also appears significant that while the kidney, liver, and duodenum show increased reductions of the dye after 60-min incubation as compared with 30-min incubation, this was not the case with the tumor and spleen, wherein little change occurred, and with sections of diaphragm, where an actual decrease in values was observed. The exact significance of this observation is not clear at present and is being studied further.

This technique is also applicable to the investigation of the effects of enzyme inhibitors on tissue respiration.

Thus the addition of sodium azide to the tetrazolium solution resulted in depression of the reduction of the dye. Typical results are indicated in Table 3, which presents

TABLE 3
EFFECT OF NaN_3 ON REDUCTION OF TRIPHENYLTETRAZOLIUM CHLORIDE BY TISSUE SLICES

Tissue	R_0^*	% Change 10^{-3}M	NaN_3^\dagger 10^{-6}M
Liver	44	-45	-11
Kidney	55	-36	-2

* R_0 = Colorimeter reading/mg tissue, dry wt, 30-min incubation.

† Sodium azide, $0.5 \times 10^{-3}\text{M}$ and $0.5 \times 10^{-6}\text{M}$ added to 3 ml of 1% tetraphenyltetrazolium solution.

the mean values for tissues from six animals, the experiments having been done in duplicate.

It appears from the data presented that triphenyltetrazolium chloride may be used in a simple and reproducible manner to study the metabolism of tissue slices and the effects of enzyme inhibitors.

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Electrolytically Induced Reactions

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Recently two examples of a novel type of induced reaction have been observed in this laboratory. Both reactions are unique in being electrolytically induced. The first is the electrolytically induced air oxidation of trivalent arsenic, As^{III} in alkaline solution. It has been observed (1) that air oxidation of As^{III} in a solution 1N in sodium hydroxide is slight. But if electrolytic oxidation of the arsenic is carried on in the same solution, oxidation occurs up to 50% in excess of that corresponding to the current used. This excess oxidation is attributed to oxygen of the air, since it is entirely eliminated if the surrounding air is displaced with nitrogen. The electrolytic process, however, seems essential.

The second reaction is the electrolytically induced precipitation of iridium with rhodium. It was observed by MacNevin and Tuthill (2) that iridium could not be deposited from an ammonium chloride solution at cathode potentials as great as -1.0 volt. But if rhodium is also present, then not only does the rhodium precipitate quantitatively at a cathode potential of -0.3 volts, but the major part of the iridium does also.

These two reactions are considered to be examples of a new type of induced reaction and it is proposed to call them "electrolytically induced" reactions.

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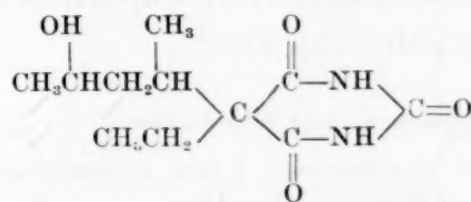
The Isolation of a Metabolite of Pentobarbital¹

E. W. Maynert and H. B. van Dyke

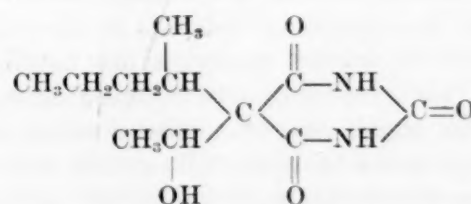
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There is general agreement that pentobarbital is excreted only in trace amounts in the urine (2, 6, 8, 9), but up to the present no metabolic products of the drug have been reported. It has now been found possible to isolate a metabolite of pentobarbital from the urine of dogs after anesthetic doses of the drug. The compound melts at 209–210° C and has an elementary composition corresponding to pentobarbital with one additional oxygen atom ($\text{C}_{11}\text{H}_{15}\text{O}_4\text{N}_2$). In sodium hydroxide solution it has the characteristic ultraviolet absorption spectrum of the dialkylbarbituric acids (5). In the range of 225–290 mμ the absorption curve has exactly the same shape as that of pentobarbital, but the extinction is about 7% lower. This would imply a molecular weight of about 242 for the new barbiturate. Further evidence for the barbituric acid ring was obtained by the preparation of a di-*p*-nitrobenzyl derivative (3).

The presence of a hydroxyl group was demonstrated by the reaction of the metabolite with acetic anhydride. A new compound was formed which crystallized from aqueous ethanol in the form of blunt needles; mp 147–148° C.



(I)



(II)

It had the elementary composition of the corresponding acetate ($\text{C}_{13}\text{H}_{20}\text{O}_5\text{N}_2$). On treatment with sodium hypiodite in dioxane solution the metabolite yielded iodoform. It would thus appear that the compound could be either I or II. Structure II would not seem likely, however, because such a compound would probably react with sodium hypiodite to yield acetic acid, not iodoform.

¹ This work was supported by a grant from the U. S. Public Health Service.

There are other reasons for favoring structure I. It would appear that ethyl groups attached to the barbituric acid ring do not suffer change in the body. For example, diethylbarbituric acid is excreted unchanged (1, 4, 7). Increasing the length of one of the chains increases the activity, but the molecules are then more susceptible to chemical change in the liver. Up to now it has not been known whether the change in the barbiturates was due to oxidation, hydrolysis, conjugation, or a combination of these reactions. It now appears likely that direct oxidative attack of side chains containing four or more carbon atoms is an important part of the chemical alteration of such compounds in the body.

The product of biological oxidation of pentobarbital is asymmetric. The isolated barbituric acid is dextrorotatory in acetic acid: $[\alpha]_D^{25} = +26.6^\circ$. It was also found to be without apparent pharmacological action after intraperitoneal injection of a large dose (180 mg/kg) into mice. Further details of this work and other experiments in progress will be reported elsewhere.

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Detection of Radioactive Impurities by the Constant Solubility Test¹

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In work with radioactive compounds, it is of importance to establish that significant amounts of the radioactivity measured in the labeled materials are not due to impurities. This is especially true in biological experiments in which the metabolism of a labeled compound is followed solely on the basis of radioactivity measurements. Radioactive contaminants in crystalline material often represent an amount by weight much smaller than can be detected by the common criteria of chemical purity. Specific procedures have been developed which take this problem into account (1). Recrystallization to constant specific radioactivity, conversion of the product to a derivative without change of specific activity, and determination of the distribution coefficients between two im-

¹ This work was supported by grants from the American Cancer Society, upon recommendation from the Committee on Growth of the National Research Council, and by the Rockefeller Foundation.

miscible solvents have been used to prove the purity of radioactive materials.

A modification of the solubility method of analysis² has been devised for the detection of minute amounts of radioactive impurities in chemical compounds. This method is especially suited to the estimation of the purity of a radioactive compound because of the high sensitivity inherent in radioactivity measurements and because of the theoretical soundness of the phase rule. The simplicity of the technique and the easy recovery of the compounds used in the tests recommend it when limited amounts of material are available.

TABLE 1
SOLUBILITY TEST OF PURITY OF RADIOACTIVE
S-BENZYL-D-HOMOCYSTEINE-S³⁵*

Time hr	Radioactivity of solution†	
	counts/sec/ml flask A	flask B
16	24.0	24.4‡
40	23.6	23.4

* The specific radioactivity was 0.43 counts/sec/γS.

† The solvent was water at 29.3° C.

‡ After this measurement 12.6 mg of solid was added.

The principle of the constant solubility test as adapted to the detection of radioactive impurities is illustrated in the following general procedure, which should be applied to a compound judged to be chemically pure: A solvent is selected in which the compound is sparingly soluble; a convenient volume of the solvent is saturated with the compound by equilibration at constant temperature; a sample of the saturated solution is withdrawn and its radioactivity is measured; more of the compound is added to the solution, and after a suitable time interval for equilibration the radioactivity of the supernatant liquid is again determined. If the compound is impure, addition of more solid will increase the concentration of impurities in the liquid phase. Radioactive impurities will increase the radioactive count per unit volume of the solution. In the absence of radioactive impurities, the radioactivity of the two samples of solution will be the same.

The sensitivity of the method is utilized to its fullest extent by employing, in the first equilibration, an amount of solid just sufficient to saturate the solution, and by adding as large an amount of solid as feasible before the second equilibration. Considerable procedural variations within the principle of the solubility test are possible. Two applications of the method are given here for illustration.

The purity of three times recrystallized S-benzyl-D-homocysteine-S³⁵ was demonstrated as shown in Table 1. This material had attained constant radioactivity in successive recrystallizations and had been converted to N-acetyl-S-benzyl-D-homocysteine-S³⁵ without change in the specific radioactivity of the sulfur. Three mg of the compound was suspended in 5 ml of distilled water in each of

² For a discussion of the scope and limitations of the solubility method of analysis as a criterion of purity see Herriott, R. M., *Fed. Proc.*, 1948, **7**, 479.

TABLE 2
DETECTION OF RADIOACTIVE IMPURITY IN L-CYSTINE

Time	Radioactivity of solution*
hr	counts/sec/ml
3	2.6
6	2.9†
19	34.9

* The solvent was water at 0° C.

† After this measurement 15.1 mg of compound was added.

two flasks. After equilibration for 16 hr, 0.5-ml samples were withdrawn through pipettes fitted with cotton filters, and the radioactivities of the solutions were determined. To one flask was added 12.6 mg of the compound and equilibration was continued for another 24 hr. At this time measurements showed that the radioactivity of both solutions had remained constant.

The presence of impurities was demonstrated in the following experiment: A sample of chemically pure L-cystine was deliberately contaminated by crystallization from a solution containing a mixture of radioactive sulfur-containing compounds. The apparent specific radioactivity of the recovered cystine was 0.039 counts/sec/ γ S. A sample of 1.5 mg of the radioactive compound was suspended in 6 ml of distilled water and samples were withdrawn after equilibration for 3 and 6 hr respectively. After 6 hr, 15.1 mg of the compound was added to the flask and an additional sample was taken after further equilibration for 19 hr. The increase in radioactivity of the solution after addition of more solid (Table 2) proved that the compound contained radioactive contaminants.

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Some Observations on Exchange of CO_2 Between BaCO_3 and CO_2 Gas¹

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Previous studies on the exchange of CO_2 between BaCO_3 crystals and atmospheric CO_2 have shown that exchange takes place in the presence of moisture (1), and that the amount of exchange can be reduced by heat treatment of the BaCO_3 samples (2). An attempt has been made to confirm these results, and to obtain additional information on the factors which affect the amount of exchange, using C^{14} .

The original BaCO_3 had a specific activity of about 1.2×10^6 cpm/mg.³ It was attempted to prepare an active CO_3^{2-} solution by heating this material with inactive

¹ Research work done at the Brookhaven National Laboratory under the auspices of the Atomic Energy Commission.

² I wish to thank Dr. William Robinson and Dr. Warren Miller for helpful advice.

³ Obtained from Oak Ridge.

$0.1N \text{ Na}_2\text{CO}_3$ for 1 week. However, no exchange occurred. Active CO_3^{2-} was then prepared by mixing active BaCO_3 with varying amounts of ordinary BaCO_3 , evolving the CO_2 by treating with $3N \text{ HCl}$ in a small glass generating apparatus, and passing the evolved CO_2 in a small stream of N_2 gas through a coiled glass tube filled with $3N \text{ NaOH}$ solution. After absorption of CO_2 , the NaOH solution was removed from the apparatus and diluted about three-fold, and BaCO_3 was precipitated, in the cold, with BaCl_2 solution. This was then filtered and washed with water, alcohol, and finally acetone to hasten drying. The filter paper with the precipitate was pasted to aluminum disks for easier handling and to prevent curling upon drying.

The effect of different amounts of moisture on the amount of exchange was studied first. The method used

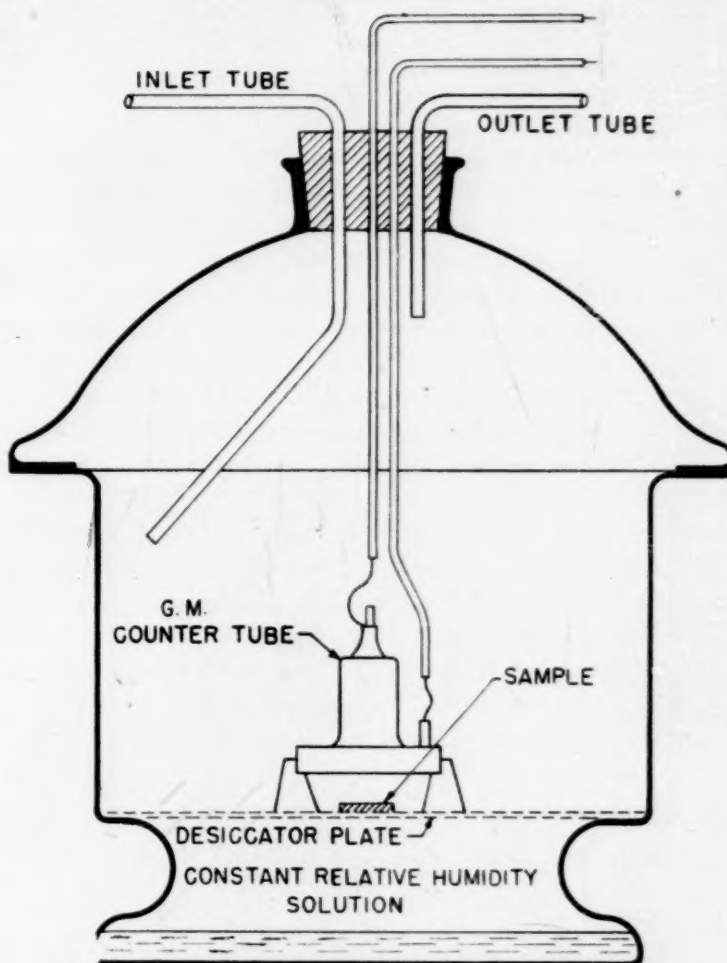


FIG. 1.

was to expose the sample to inactive CO_2 in a static atmosphere of known relative humidity, and to compare the counting rates of the sample before and after exposure. This was performed in a closed desiccator, as shown in Fig. 1. The bottom of the desiccator contained sulfuric acid solution of a density adjusted so that a known constant relative humidity was obtained.

The sample was placed beneath the tube and counted. CO_2 was passed into the desiccator for 15 min and then the vessel was sealed for 2 hr. At the end of this time, air was blown through to sweep out the CO_2 , and the sample was recounted.

The addition of CO_2 into the desiccator causes the count to drop 25% to 40% of the count in air, due to increased absorption of β -rays by CO_2 . However, all counting was done with air in the desiccator.

The results of the first set of experiments are given in Table 1. Each line represents a freshly prepared sample.

TABLE 1

Relative humidity in %	Wt of sample in mg	% Decrease in counting rate	
3.2	17.7	1.5	Prob. Error $\pm 0.3\%$
3.2	15.8	1.2	
47.2	16.9	1.3	
47.2	17	1.3	
47.2	16.8	1.4	
75	17.3	1.4	$\pm 0.5\%$
75	29.7	2.5*	
18.8	14.7	2.4*	
18.8	13.7	2.3*	
18.8	14.2	2.3*	

* Samples were prepared from a different active Na_2CO_3 solution.

The decrease in counting rate after exposure is taken to be a measure of the amount of exchange between CO_2 and BaCO_3 . The results indicate that the amount of moisture present has no effect on the amount of exchange, at least so long as the relative humidity exceeds 3%.

Armstrong and Schubert (1) reported that thorough mechanical mixing of the barium carbonate after treatment caused no change in activity. This was interpreted as proof that exchange took place throughout the sample. This conclusion was confirmed by a different method, as follows.

A group of five samples was made up, each containing the same amount of activity, but varying in weight in steps up to 10 mg. Each sample was exposed to CO_2 in the manner already described, except that the CO_2 was moistened before being passed into the desiccator. The bottom of the desiccator contained water. After 2 hr the CO_2 was blown out and the sample was counted.

TABLE 2

Sample thickness mg/cm ²	Loss of C^{14}O_2 in %	
0.56	3.8	Prob. Error $\pm .5\%$
2.13	3.8	
2.59	3.8	
3.24	3.8	
4.44	3.9	
1.3	2.6*	$\pm .4\%$
1.6	2.8*	
2.3	2.5*	

* Samples made from a new batch of Na_2CO_3 solution.

These results indicate nothing about the amount of exchange undergone by a single crystallite in the sample, but they do show that all crystallites in the body of the sample suffer exchange.

The following experiment was set up to determine the effect of heating on BaCO_3 samples. Yankwich (2) reported that heating BaCO_3 resulted in samples that could be stored for long periods without serious loss of activity.

Several samples were heated separately in air for $\frac{1}{2}$

⁴ All Na_2CO_3 mentioned in the article contains active carbon.

hr, 1 hr, and $1\frac{1}{2}$ hr at 140°C . Each sample was then exposed to moist CO_2 for 2 hr and counted. Those samples which were heated for $1\frac{1}{2}$ hr showed no exchange. Those which were heated for less time showed small, varying amounts of exchange.

TABLE 3

Preparation	Particle size	Exchange %	
Samples prepared by slow pptn. from hot soln.	Coarse crystals	0.0	Prob. Error $\pm .6\%$
Samples pptd. at room temperature	Fine ppt., readily filterable	1.8	
Samples prepared from ice cold soln.	Fine ppt., clogged filter	1.7	
		4.5	

It was found that heating an active sample in air caused a loss of activity varying between 2.5% and 3%. However, when the samples are heated in an evacuated bulb, or in an atmosphere of nitrogen, this loss does not occur, and the sample is stabilized against subsequent exchange.

The next group of experiments was to determine what effect particle size had on the amount of exchange. Three sets of samples were made up. One set was made by dropwise precipitation over a 2-hr period from a very dilute solution kept at just below boiling temperature. Another was made at room temperature, and a third was made with a concentrated BaCl_2 solution from a semi-frozen solution of Na_2CO_3 . Table 3 shows the results.

The final experiment was designed to get some idea of how the percent exchange depends on the time of contact. The rate of flow of CO_2 into the desiccator was kept as constant as possible from one sample to the next. After the CO_2 was blown into the desiccator for the time re-

TABLE 4

Time CO_2 was in contact with sample, in min	% Loss	
15	3.8	Prob. Error $\pm .4\%$
15	4.1	
10	3.7	
10	3.2	
5	2.4	
5	2.3	
5	2.1	
2	2	
1	1	

quired the flow was turned off, and immediately air was passed through for 15 min. The samples for this experiment were precipitated from ice cold Na_2CO_3 solution to take advantage of the higher percent exchange which can be obtained by this procedure. The results are given in Table 4, and suggest that under these conditions, the exchange has almost reached its limiting value in 15 min.

The observations indicate that a small amount of moisture will be sufficient to cause exchange between BaCO_3 and atmospheric CO_2 . However, the amount of

exchange taking place depends on the size of the particles; the larger the particles, the less the exchange. This indicates that exchange takes place on the crystal surface. Heating of the BaCO_3 sample or preparing it by some method giving very large crystals will make exchange negligible.

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Modifications of the Rabbit Ear Chamber Technique¹

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The rabbit ear chamber provides a valuable technique for the microscopic study of living vascular tissue over a period of weeks or months. The basic design has been described (1-3), but in the course of the past three years various modifications have been made which simplify the

entirely of Plexiglas except for a mica cover slip. The cover slip's supporting ring (A) has an outside diam of $\frac{1}{8}$ in. and an inside diam of $\frac{3}{8}$ in. It is 0.080 in. thick. The top is beveled at the angle shown in cross section (C) to prevent high power objectives from striking the edge of the ring. A piece of clear mica 50-60 μ in thickness is glued to the supporting ring (A and C).

The chamber base (B and D) has a diam of 1 in. and the base plate (B and D) is $\frac{1}{16}$ in. thick. A central observation table $\frac{1}{4}$ in. in diam projects $\frac{3}{32}$ in. above the base plate. If access to the thin layer of tissue on the table is desired, a removable plug with a shaft diam of $\frac{1}{16}$ in. may be made to fit loosely into a hole drilled through the base plate and central table (B and D). It is important to have this fit loosely, because serum which seeps around the plug makes it difficult to remove the plug after new tissue has grown onto the observation table.

The cover slip ring (A and C) fits tightly onto three notched Plexiglas pegs (B and D), 0.109 in. in diam, inserted at the periphery of the base plate and cemented with glacial acetic acid. The notches (D) are elevated .002 in. above the level of the table. The height of the notches above the table determines the thickness of the new tissue which grows between the cover slip and observation table and eliminates the need for buffers previously described (1, 2). After the ring has been snapped into place, it is secured by a drop of Lucite in chloroform over each peg.

The operative technique for inserting the chamber has been described (1, 2). To insert the chamber, four holes are punched through skin and cartilage near the tip of the pinna; a central hole to accommodate the central table and three peripheral holes for the pegs. A steel punch (G) has been designed to cut the four holes at one time and insure an exact fit. Three peripheral punches are attached to a handle in the exact positions of the Plexiglas pegs and made 0.015 in. larger than the diam of the pegs. A fourth punch, 0.015 in. larger than the central table diam, is attached centrally. The punches are $\frac{3}{4}$ in. long and have notched ends. A Plexiglas guide (E, F) permits visualization of vessels when holes are punched and keeps the ear perfectly flat. The guide is made in two pieces, each $5\frac{1}{2}$ in. in length, $1\frac{1}{4}$ in. wide, and $\frac{5}{8}$ in. thick. Steel connecting pins, $\frac{1}{4}$ in. long and $\frac{3}{16}$ in. in diam, connect the two plates when in use. Punch holes are placed at one end and are made 0.001 in. larger than the diam of the corresponding punch. The end of the ear is slipped between the two plates and when the template has been placed so that the central artery is adjacent to the central hole and no major vessels will be cut by the punches, the plates are pressed tightly together. The guide is then held firmly against the table and the holes are punched.

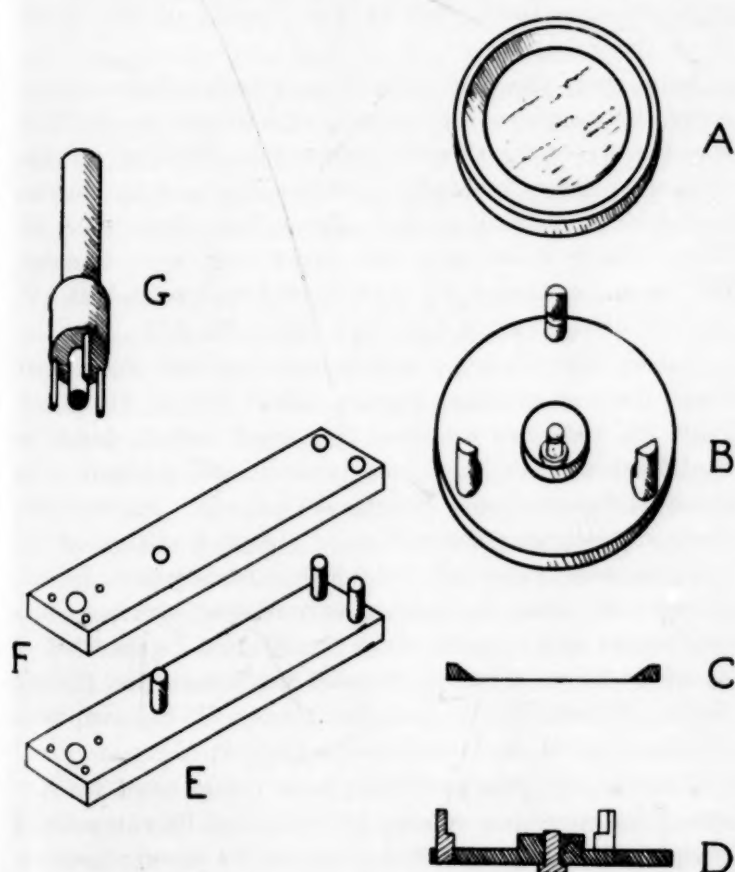


FIG. 1.

procedure. Since the changes may be of help to others using the method, they are presented here.

A modified chamber has been designed, constructed

¹ This investigation was supported by a research grant from the Division of Research Grants and Fellowships of the National Institutes of Health, U. S. Public Health Service.

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Comments and Communications

On the Mental Ability of the Dog

As part of a long range research program on the relation between genetics and behavior, we are very much interested in the problem of mental ability in the dog. We therefore read the communication entitled "Concerning a Dog's Word Comprehension" (*Science*, May 13, p. 494) with great interest. While we are probably sufficiently biased to believe that the reported word comprehension ability is true, we are not convinced that the evidence is sufficient to be passed off as a scientific fact. There can be no question but that the dog is an intelligent animal—how intelligent, and what factors of intelligence it possesses remain to be experimentally demonstrated. We are assembling a battery of mental tests for the dog by means of which we believe it may be possible eventually to demonstrate the existence of the factors of space perception, memory, reasoning, and movement perception.

The point to be made here is that there can be no question that the dog is capable of what we might call intelligent behavior. The question is whether the dog's understanding moves over into the realm of our particular language. The report of Eckstein smacks of the "anecdotal" period of comparative psychology and is replete with lack of even obvious controls. As examples, no mention is made of the "Clever Hans" error, apparently no trials were made in which the experimenter said (in the same tone of voice) "La mesa, Topper," or "Borscht, Topper," not to mention the fact that there is complete lack of any statistical consideration of the element of chance with respect to the animal's behavior.

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Citation of Botanical References

The present confusion in citing botanical references, with some publications following several conflicting systems and others without consistent practice, is absurd in an orderly science. A standard system is badly needed. Perhaps a simple set of rules for citation could be formulated and adopted by representatives of botanical societies, editors of botanical publications, and bibliographers at an annual scientific meeting, such as that of Section G of the American Association for the Advancement of Science at New York City this month.¹ Then, at the Seventh International Botanical Congress at Stockholm next year, further efforts should be made to obtain international agreement upon a uniform system for citations

¹ An open discussion meeting on botanical citations in the literature now has been scheduled for the New York City meeting at 9:30 p.m., Tuesday, December 27, in the Colonial Room of Hotel McAlpin under sponsorship of the Committee on Publications of the American Institute of Biological Sciences.

which the majority of botanists in many countries will accept and follow voluntarily.

Some years ago, E. D. Merrill (*Science*, 1925, 62, 419) suggested shorter and simpler ways of citing scientific references, remarking that the average editors and authors were ultraconservative. As he stated, an author preparing a paper for a certain journal and then later submitting it to another frequently has to rewrite parts to conform to the different style of citations used in the second. Some authors have the attitude, "What's the use of having an editor, if not to do these chores?" An editor quoting that remark, C. A. Shull (*Science*, 1931, 73, 363), justly criticized authors for carelessness and mistakes in spelling, citing titles, volumes, years, etc.

An anonymous university scientist (*Amer. Sci.*, 1947, 35, 306 ff.) has advocated that, instead of striving for consistency in citations and other details, editors should relax and accept an author's own tastes and print the manuscripts as they come, provided they are done in some regular manner. As a possible solution he suggested the voluntary adoption of a uniform standard by journals generally or by separate branches of science through a representative body, such as The Society of the Sigma Xi or the AAAS.

Apparently the only system for citations officially accepted by a representative group of botanists in the U. S. was the *Rules for Citation* adopted in 1893 by the Botanical Congress in Madison, Wisconsin, and by Section G, AAAS (reprinted in *Bull. Torrey bot. Club*, 1895, 22, 130). These *Rules*, only two pages long, were summarized in a paragraph by Lazella Schwarten and H. W. Rickett (*Bull. Torrey bot. Club*, 1947, 74, 348).

Noting that the good, widely used Madison *Rules* have stood the test of time, Rickett (*Bull. Torrey bot. Club*, 1948, 75, 166) has proposed that, with certain desirable modifications, they be given international authority by the next International Botanical Congress. He has further proposed that the editors of the next edition of the *International rules of botanical nomenclature* be instructed to bring its present inconsistent citations into conformity and that the rules for citation be inserted as an appendix to serve as a model for future use (Camp, W. H., Rickett, H. W., and Weatherby, C. A., compilers. *Brittonia*, 1947, 6, 3; and *ibid.*, 1949, 7, 51).

However, the Madison *Rules* seem rather brief for covering the enormous volume of botanical literature with complex citations which has arisen in the present century. A system which has been in use more than 50 years should be improved by some revision, anyway. I urge the botanists within the U. S. to act promptly now and agree upon a set of rules for citation before requesting international approval at the Stockholm Congress in 1950.

First, several more or less obvious general principles should be established. In nontechnical publications for general readers it may be best to list references in full.

The chief purposes of shortened citations of botanical references are to save time of authors and readers and to save space and to avoid repetition on the printed page. Though a citation should be short and simple, clarity must not be sacrificed to achieve brevity. Citations should be sufficiently clear not only to specialists in a narrow field of botany but also to botanists in general, workers in applied plant sciences and related fields, editors, and librarians. Citations should not be so short that readers waste time in deciphering them, nor so ambiguous that they fail to guide readers to the correct volume and page. Within one article, and among the issues of the same periodical, citations should be consistent. And wide, voluntary adoption of the same rules by many different periodicals and serials is an important objective.

Botanical indexes and bibliographies. Each of the four leading botanical indexes and bibliographies published in the U. S. has its own system of citing references. "Index to American Botanical Literature," published bi-monthly in *Bulletin of the Torrey botanical Club*, and also printed on cards for libraries, began in 1886 and is the oldest. It follows the *Madison Rules* and its own published list of abbreviations of periodicals by Swarthen and Rickett and is now prepared in the library of the Arnold Arboretum of Harvard University.

Each monthly issue of *The Agricultural Index* contains a list of abbreviations used for the periodicals and bulletins indexed. This system of extreme abbreviations without periods, like that in city telephone directories, may be justified for special bibliographies to save space and expense, but is not a model to be followed by botanists in their scientific writings. *Biological Abstracts* has no published summary of its rules but in each May issue lists, without abbreviations, the periodicals and serials covered.

Bibliography of Agriculture, a monthly publication of the U. S. Department of Agriculture Library, follows the Department of Agriculture's *Citations to literature* by Carolyn Whitlock (*Citations to literature in the Journal of Agricultural Research, technical bulletins, circulars, and miscellaneous publications [other than bibliographies]*, U. S. Dept. Agric., 1940), which was published in 1940, replacing shorter rules issued in 1927. It adopts, with nine shortened exceptions, *Abbreviations used in the Department of Agriculture for titles of publications*, also by Whitlock (*Misc. Publ. U. S. Dept. Agric.*, 1939, 337, 278 pp.). These directions for citations have been developed through the years by the Department of Agriculture, the largest institution of plant scientists in this country.

If as many as three of these four indexes and bibliographies could agree in citing botanical references, this system probably would become widely adopted throughout the U. S. Then international agreement would be simpler when compromises with systems in other countries and other languages are sought.

Revised rules. A uniform system of rules for citation could be developed through consolidation of the two-page *Madison Rules* for citation and the 15-page *Citations to literature* used in the U. S. Department of Agriculture into one of intermediate length with some exceptions per-

mitted. There should be many well-chosen examples of both ordinary and complicated references.

With the main rules of the Department of Agriculture as a base, I shall list some of the more important features of a proposed revised system, including several items upon which agreement is unnecessary and omitting minor details. The revised rules should provide separately for the two groups of botanical references, books, and articles in periodicals.

The essentials of a reference in the two groups, as quoted from the Department of Agriculture directions (p. 2), are:

A book citation should include author, date, title, edition (except first), pagination or volume, illustrations, and place of publication. Important series may be noted.

A periodical citation should include author, date, title of article, title of periodical, series, volume, pagination, and illustrations. Number or part is given only when it is separately paged, or is necessary for finding the reference easily.

The revision should contain additional provisions for citation of scientific names, the special, shortened form used by plant taxonomists in citing place of publication of scientific names of plants, including synonyms. Many details are the same as in book and periodical references, but the differences are beyond the scope of this article.

In some periodicals, as well as U. S. Department of Agriculture publications, the listed references are numbered and cited in the text by number. In others they are cited in the text by author and year. Each method has certain advantages and limitations.

Book citations. Citations of author and title are the same for both books and periodical articles and seldom present problems. Special cases are covered in the Department of Agriculture directions (pp. 4-9). Name of author should be given as in original publication, rather than with initials only, and the title, unless it is very long, is cited in full.

In ordinary botanical citations the less important items, not needed in finding the reference, are preferably omitted. These items include the preliminary pages of a preface or introduction, numbered with Roman numerals, the number and kinds of illustrations, and the name of the publishing company. The abbreviation "illus.," as used by the Department of Agriculture, is sufficient to indicate that the reference is illustrated. Where desirable, numbers and kinds of illustrations may be indicated by "pl." for plate and "f." for figure. However, use of italics for illustrations, as provided in the *Madison Rules*, is not general and should remain optional. Arabic numerals are better, even for plates bearing Roman numerals. Definite action should be taken on whether to abbreviate pages as "p." or "pp."

Periodical citations. These differ from book citations chiefly in including an abbreviated title of the periodical. The *Madison Rules* call for series in Roman capitals, whereas the Department of Agriculture directions state that series numbers should be set off by commas (my choice) or in parentheses preceding volume number.

Under both systems, volume numbers are in Arabic numerals, followed by colon, space, and page number. How-

ever, boldface numerals for volumes, specified by the *Madison Rules* and supported by Rickett (*Bull. Torrey bot. Club*, 1947, 75, 166), are not used by the Department of Agriculture and should be optional. They require extra care and time of author, editor, and printer but do not stand out noticeably and do not assist the reader materially. Besides, publications reproduced from type-written copy by offset process, which are multiplying rapidly and which include both *Bibliography of Agriculture* and *Biological Abstracts*, cannot use boldface type. Roman numerals for volumes, still retained in some conservative publications, most of them foreign, should be abandoned.

Agreement is needed on how to cite the number or part of a periodical when separately paged. The *Madison Rules* provided for writing the separately paged part as a small upper number, such as used in numbering footnotes and variously called a superior figure, index figure, or superscript number. However, superscript numbers have objections similar to those of boldface numerals. I prefer the Department of Agriculture method of citing separately paged numbers or parts in parentheses between volume and colon.

Ordinarily the year of the particular issue is sufficient in citation of the date of a periodical article. The *Madison Rules* recommended that the exact date be given, if possible, with the following abbreviations of months used by the Library Bureau: Ja, F, Mr, Ap, My, Je, Jl, Ag, S, O, N, D. However, the conventional abbreviations of months are clearer to readers, both English-speaking and foreign.

Abbreviation of titles of periodicals. The item in which usage probably varies most widely is abbreviation of titles of periodicals. Fortunately, most shortened titles are readily understood even though inconsistent. A list of these abbreviations was mentioned in the *Madison Rules* but was never published. Agreement on abbreviations is less important than accord upon numerals and typographical devices, and could be considered separately when the rules are revised.

The most detailed reference on this subject is Whitlock's *Abbreviations used in the Department of Agriculture for titles of publications*, issued in 1939 and following earlier lists of 1905 and 1925. It contains a valuable list of abbreviations for single words (pp. 258-278) for preparation of uniform citations of older and newer periodicals and changed titles. Some botanical bibliographies, such as those by S. F. Blake and Alice C. Atwood (*Misc. Publ. U. S. Dept. Agric.*, 1942, 401, 262) and by Alfred Rehder (*Bibliography of cultivated trees and shrubs*. Jamaica Plain, Mass.: Arnold Arboretum of Harvard University, 1949. Pp. xvii-xxxvii.), have their own special lists of abbreviations of the periodicals cited.

Three arrangements of citation based upon the order of words or abbreviations are used: (1) by strict order of title; (2) by name of institution or society, if a part of title; or (3) by place of institution or society. Thus, *Proceedings of the biological Society of Washington* may

be abbreviated: (1) *Proc. Biol. Soc. Wash.*, (2) *Biol. Soc. Wash. Proc.*, or (3) *Wash. Biol. Soc. Proc.*

The first arrangement, with abbreviations in order of title, is the simplest and most widely adopted, being used in *Abbreviations of periodicals cited in the Index to American botanical literature*, by Schwarten and Rickett, and by many botanical periodicals. The Department of Agriculture and *The Agricultural Index* follow essentially the second order. State publications are listed with abbreviation of the state first, publications of the U. S. Department of Agriculture and other departments are under "U. S.," and foreign government publications are entered under names of countries. Advantages for placing institution, society, or state first are that most libraries catalogue periodicals in this manner and that all publications of one organization are listed together.

Many titles, those not containing the name of an institution or society, have the same order under all systems. The second and third arrangements agree with the first for many titles and with each other for most, also. Published lists reveal that slight inconsistencies may occur in any system. None of these arrangements is greatly superior to the others. If agreement upon one is not possible, perhaps the best features of two systems could be combined satisfactorily, or one might be adopted with certain exceptions allowed.

Which words to omit in abbreviations of periodicals is a problem. Rickett (p. 167) stated that "*Bot.*" can be omitted in an exclusively botanical work. Thus, Schwarten and Rickett listed *Bull. Torrey Club* for *Bulletin of the Torrey botanical Club*, *Jour. Wash. Acad.* for *Journal of the Washington Academy of Sciences*, etc. Rather, the question is whether the readers are exclusively botanical. I urge retention of these parts indicating contents, such as "*Bot.*," "*Sci.*," and "*Agr.*," as essential for clarity and for helping nonbotanical readers, students, foreigners, and librarians to find the references.

How much to abbreviate each word is another item in which usage varies too much. For example, *Journal* is reduced to "*Journ.*," "*Jour.*," "*J.*," and "*J.*," and *Bulletin* to "*Bull.*," "*Bul.*," "*B.*," and "*B.*." Rickett (p. 168) has noted that Recommendation XXX of the *International rules of botanical nomenclature*, for abbreviating authors' names, serves admirably for titles.

Possibilities for variation and originality in citing botanical periodicals are almost unlimited. The number of words may vary, their order may be changed, and the abbreviations of words may differ in length. As an illustration, I have found in current usage for *Journal of the Washington Academy of Sciences* eleven different abbreviations. Isn't all this variation rather silly? A partial solution is more one-word periodicals and serials in the future, as discussed by E. D. Merrill (*Brittonia*, 1931, 1, 1), or even two-word periodicals. A one-name title, such as *Science*, is not abbreviated and cannot be reversed.

ELBERT L. LITTLE, JR.

U. S. Department of Agriculture, Forest Service
Washington, D. C.

Book Reviews

Human behavior and the principle of least effort: An introduction to human ecology. George Kingsley Zipf. Cambridge, Mass.: Addison-Wesley, 1949. Pp. xi + 573. (Illustrated.) \$6.50.

This is one of the most ambitious books ever written. Its expressed purpose is "to establish the Principle of Least Effort as the primary principle that governs our entire individual and collective behavior of all sorts"; there is an allusion to Hamilton's Principle of Least Action in mechanics. Even more ambitious would be the reviewer who would presume to offer a final appraisal now of the full degree of the book's success. Unquestionably a large part of it will withstand the test of time and will grow in influence, whether or not Least Effort becomes generally accepted as a fundamental coordinating principle of human behavior.

In an age of academic superspecialization, work like this is altogether different and refreshing. It cuts across departmental and divisional boundaries as nothing else has for a century. Language, vocabularies, the ego, sex, schizophrenia, theory of art, human geography, the structure and relations of cities, the incomes and social status of individuals, prestige symbols, and cultural vogues—these are some of the subjects treated with a continuous attempt at closely knit reasoning, modeled in large measure on the reasoning of physical science and at a great many points tested against a wealth of systematic quantitative observations. The extensive recapitulation and bibliography of these alone would make the book a very valuable contribution to empiric social science.

Zipf, unlike most contributors to social studies, is fully aware of the usefulness of empirical mathematical regularities as a stage between observation and theory. Many of the interesting ones cited are his own work or his students'; evidently he possesses the enthusiasm which stimulates volunteers to undertake a long and tiresome count for the sake of establishing some empirical formula which of necessity at that stage completely lacks "meaning."

Social statisticians have expended a huge and commendable amount of labor and funds in gathering data, while relatively few investigators have tried to condense these shelves of statistics into roughly approximate empirical rules. Tables or graphs which compare computed with observed quantities are all too rare in the social field. A principal reason seems to be that social scientists are not trained in such work, nor are they readily able to make use of its results. This is because they are accustomed to looking for "meanings" intelligible in ordinary human terms and related to general ideas previously advanced.

As one example of detailed data presented (pp. 23-24),

the novel *Ulysses*, according to the studies of Hanley and Joos, has 260,430 running words and 29,899 different words. When the latter are listed in the decreasing order of the frequency of their occurrence in the novel, the product of the rank of a word by its frequency roughly approximates 29,000 in every case, throughout the series of 29,899 different words. Of course those at the tail end of the list are used only once apiece, so that the last product is exactly 29,899. To the conventional student of language this empirical rule, rank times frequency equals a constant, is "meaningless" and uninteresting.

To an investigator with George Kingsley Zipf's insight and originality this regularity, which he finds repeated again and again in other widely varying data, is surprising and exciting and offers a key to major principles of human activity. He applies it with aid of the concept of "tools-which-must-match-their-jobs."

Wisely, or not, the author here and there indulges in satire: some of his remarks about the "Pied Piper morality" (pp. 478 f.) are an instance. Galileo was a satirist too; and, while that got him into deeper troubles, perhaps logic needs satire to enliven it when new thoughts are being advanced in the public market.

There are readers who will regret the slow pace of some of the pages, while others will be grateful for the consequent easy steps in the reasoning. It would not be difficult for a commission of experts to comb through this book and suggest minor improvements. It was E. U. Condon, not "E. V. Condon," (p. 546) who made an early suggestion of the rank-times-frequency rule for a vocabulary. Again, (p. 386) Ravenstein's study of migration (1885) is quoted as the pioneer notion of the existence of the formula, population divided by distance. However, Ravenstein did not suspect, as a much earlier writer did, that this formula had general application to the relations of people with people. Henry C. Carey, of Philadelphia, in 1859 gave what he called the "molecular gravitation" of people for people, and the activities resulting from their association, leading roles in his three-volume *Principles of social science*. Although his treatment was wholly verbal, it parallels this and other physical formulas mentioned by Zipf.

No reviewer can be a competent substitute for a commission of experts in "economics, sociology, cultural anthropology, psychology—both general and Freudian—linguistics, and semantics," which are relevant fields listed by the author. But the present reviewer is sure he can detect in this book the definitive beginning of a new, less confined, and more humanly productive era in research.

JOHN Q. STEWART

Princeton University

(Continued from page 651.)

logical and medical sciences would continue at its present level with the indicated redirection of emphasis.

3. Fellows now under appointment are to be candidates for reappointment under the criteria for scientific competence previously applied by the National Research Council, without regard to the additional requirements listed in the previous paragraphs.

4. The National Research Council is to have no responsibility for loyalty determination procedures other than submitting to the Commission the names of fellowship applicants and the names of those applicants judged by the Council to merit fellowships on the basis of scientific promise. Public announcement is to be made that the National Research Council will notify applicants of acceptance or rejection on scientific grounds, and the Commission will notify applicants of acceptance or rejection on grounds of security or loyalty.

It is our opinion that a fellowship program thus reconstituted would make a valuable contribution to the work of the Commission. The administrative experience of the National Research Council, and its established reputation for sound scientific judgment, would guarantee maximum effectiveness of such a program. These arguments have guided us in proposing for your consideration the plan outlined above.

We would like to express to you and to your fellow members of the National Academy of Sciences our gratitude for the attention and study you have given to the fellowship question. It is our sincere wish that an early agreement can be reached.

Letter dated November 30 from Alfred N. Richards, president of the National Academy of Sciences, to Carroll L. Wilson, general manager of the U. S. Atomic Energy Commission:

In response to your letter of November 17, amplified by two subsequent memoranda from Dr. Warren, I can now inform you that, should you make the request, the National Academy of Sciences will authorize the National Research Council to administer a new program of AEC fellowships consisting of the following provisions:

1. No new predoctoral fellowships will be offered.
2. In order that commitments in announcements of the predoctoral fellowships and of the postdoctoral medical fellowships for 1949-50 shall be fulfilled, applications for renewal of current fellowships in those categories will be solicited by the National Research Council and renewal recommended for those whose progress warrants it. However, because of the amendment to the Independent Offices Appropriation Act of 1950, such recommendations can become effective only after the applicant has been investigated as to character, associations and loyalty by the

Federal Bureau of Investigation and clearance given by the Atomic Energy Commission. Hence those whose applications for renewal are approved by the National Research Council will receive from the Atomic Energy Commission a copy of the amendment referred to above and a personnel security questionnaire which must be filled out and returned before the FBI investigation can be initiated. Decisions by AEC, based upon the FBI report, will determine the fellowship awards.

3. The National Research Council will administer a limited program of postdoctoral fellowships in the physical sciences, biology, biophysics and medicine for advanced training in fields of secret work or in problems which require access to restricted data. For holders of these fellowships, FBI investigation and full security clearance constitute an accepted requirement.

In the physical sciences, the fields of study will be limited to those closely related to the AEC program, such as the chemistry and nuclear physics of elements of atomic number greater than 90, the neutron physics of various elements, the effects of high energy radiation on matter, the chemistry of the elements in the fission-products range and the separation of isotopes.

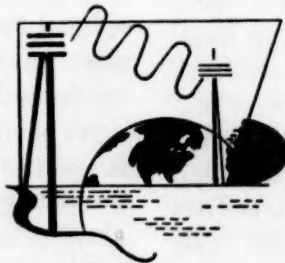
In biology, biophysics, and medicine, the research fields will include experimental aspects related to atomic energy which require the use of the special facilities available in the AEC installations and/or access to restricted data. This work would include studies such as the physiological and toxicological effects of fission products, and the development of radiation instruments as applied to biological and health physics problems of a classified nature.

Since, in this postdoctoral program, considerations of classification policy, security clearance and the AEC program play so great a part, it is deemed inappropriate for the National Research Council to agree permanently to administer it; hence the administrative commitments set forth in this letter do not extend beyond June 30, 1951.

* * * * *

I think you understand that the radical change from the previously existing AEC fellowship program represented by the provisions stated above is the consequence of the belief held by the Council of the National Academy and by the majority of its members who have expressed themselves that FBI investigation of AEC fellows who work in non-classified fields and who do not have access to restricted data is unnecessary from the standpoint of the national security and unwise from the standpoint of the advance of science in the United States.

It is also understood that had the Atomic Energy Commission determined to conduct the administration of a broader fellowship program, the National Academy and the National Research Council would have been glad to assist with scientific advice to the full extent of their competence.



NEWS and Notes

Physicists **Robert J. Oppenheimer** and **Ernest O. Lawrence** and naturalist **Fairfield Osborn** have been appointed to the college of electors of the Hall of Fame for Great Americans on the campus of New York University. Of the 120 Americans now serving on the electoral body, eight are scientists. The new appointees will vote on the 1950 nominees to the Hall of Fame.

The National Institute of Sciences of India has elected as Honorary Fellows **Harlow Shapley**, director of Harvard Observatory, **Louis de Broglie**, French physicist, **Hans van Euler**, Swedish chemist, and **George Tishler**, German botanist.

H. Keefer Hartline, professor of biophysics and chairman of that department at Johns Hopkins University, has been appointed to succeed **Robert D. Fowler** as the scientific representative from Johns Hopkins on the Board of Trustees of Associated Universities, Inc. The board is one of the governing bodies of the Brookhaven National Laboratory.

Manfred Bleuler, director of the Psychiatric Clinic Burgholzli, and professor of psychiatry at the University of Zurich, Switzerland, has joined the staff of the Payne Whitney Psychiatric Clinic, New York Hospital, and will spend a year in research on the etiology of alcoholism. The research project was begun at the clinic three years ago through the support of the National Research Council. Dr. Bleuler has also been appointed lecturer in psychiatry at Cornell University Medical College.

Raymond W. Darland, associate professor of botany, has been appointed head of the Department of Biology of the University of Minnesota, Duluth Branch, succeeding **Olga Lakela**, who will become curator of the university's herbarium.

Hugh McCulloch, chief of the medical staff of LaRabida Jackson Park Sanitarium, Chicago, has been appointed professorial lecturer in pediatrics at the University of Illinois College of Medicine. The college has also announced the appointment of **Sigvald B. Refsum**, who came here recently from Oslo, Norway, as professorial lecturer in psychiatry. Dr. Refsum is conducting research in electroencephalography with **Frederic A. Gibbs** in the Consultation Clinic for Epilepsy.

S. Kenneth Love, chief of the Quality of Water Branch of the U. S. Geological Survey's Water Resources Division, has been elected chairman of the American Chemical Society's Division of Water, Sewage, and Sanitation Chemistry.

Harold A. Abramson, assistant clinical professor of physiology, Columbia University, has been appointed chief of the Allergy Clinic at the Mount Sinai Hospital, New York City.

Paul Delahay, research associate at the University of Oregon, Eugene, has been appointed assistant professor of chemistry at Louisiana State University, Baton Rouge.

Florence M. MacLean has been appointed clinical director of the Occupational Therapy Section, Department of Physical Medicine, University of Illinois.

John H. Barr, associate professor of medicine, University of Texas School of Dentistry, has been appointed director of clinics and professor of clinical dentistry in the Tufts College Dental School.

Visitors to U. S.

Recent visitors at the National Bureau of Standards included **A. E. Blouin**, **W. E. Cowie**, and **L. G. Wilson**, of the Defense Research Chemical Laboratory, Defense Research Board, Ottawa; **George Miller**, professor of physics at the National University of Colombia, Bogota; **Roman C. Bieber**, instruments engineer, Lonza, Ltd., Switzerland; and **R. R. Warnecke**, chief, microwave tube research, Compagnie Generale de Telegraphie Sans Fil, Paris.

Fellowships, Scholarships, and Prizes

The National Research Council announces the availability of the Merck Postdoctoral Fellowships for 1950. These fellowships are designed to give special training and experience to young men and women who have demonstrated ability in research in chemical or biological science, and who wish to broaden their fields of investigation. Fellowships are open to citizens of the U. S. with training in chemistry or biology equivalent to that represented by the Ph.D. degree. All fields of chemistry or biology, including the preclinical medical sciences, are open to applicants for these fellowships, and special consideration will be given to applicants who wish to supplement their specialty with work in another field. Applications must be filed before *January 15*. Awards will be made as soon as possible after March 1 and, unless otherwise arranged, tenure will begin on July 1. Appointments will be made for one year; in exceptional cases applications for renewal will be considered. Further information and application blanks may be obtained from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

The Society for Pediatric Research has appointed seven additional **Mead Johnson Fellows** for the academic year 1949-50. They are **C. T. Lee**, China; **Solomon A. Kaplan**, South Africa; **Carlos A. Bauza**, Uruguay; **Isabelle Valadian**, Lebanon; **Ramón Sanz Muñoz**, Mexico; **Dacio Pinheiro**, Brazil; and **Jorge Arguedas Soto**, Costa Rica.

The Life Insurance Medical Research Fund invites faculty members to nominate candidates for 1950-51 student fellowships for research in the medical sciences (pre-doctoral). These fellowships are open to those who will have completed one year or more of work in a medical or graduate school and are in a position to devote at least three-quarters of their time to research. Preference is given to those who wish to work on fundamental problems in

cardiovascular function. The usual stipend is at the rate of \$1,600 to \$2,000 per annum. Candidates must be nominated by investigators who are willing to sponsor them on the basis of personal knowledge. The closing date for 1950 nominations is *February 15*. Further information may be obtained from the Scientific Director of the Fund at 2 East 103d Street, New York City 29.

The Northeastern Section of the American Chemical Society has announced a new award for outstanding achievement in the teaching of chemistry in honor of the late James F. Norris. It was made possible by a bequest of the late Mrs. Anne C. Norris, of Cambridge, Massachusetts, to perpetuate the memory of her husband, who was twice president of the American Chemical Society and a director for eleven years. Teachers from schools, colleges, and universities are eligible. The award will consist of an inscribed certificate and a sum of money to be awarded biennially, in the years when the Richards Medal for achievement in research is not given by the section.

Summer Studentships and Thesis Fellowships are being offered to qualified graduate students in pure and applied mathematics at the National Bureau of Standards' Institute for Numerical Analysis at the University of California, Los Angeles. The studentships are for a 10-week term from the middle of June to the end of August, with stipends from \$500 to \$700. The thesis fellowships are fixed at approximately \$2,000 for an 11-month working year, provided the candidate already possesses an M.A. degree or equivalent experience. Preliminary applications must be submitted before *March 1*. Further information may be obtained from the director of research of the institute.

The third annual competition of the Engineering Undergraduate Award and Scholarship Program has been announced by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. Awards ranging from \$1,000 to \$25, and \$1,750 for seven scholarships will be given to students and schools for the best pa-

pers prepared by undergraduates on are welded design, research, fabrication, or maintenance. Papers must be submitted before *May 15, 1950*. A copy of rules and conditions may be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

Grants and Awards

Grants for support of medical and biological research totaling \$835,770 have been announced by the U. S. Public Health Service. The awards will go to 61 institutions in 29 states, the District of Columbia, and 3 foreign countries and will aid research in a wide range of subjects including nutrition, use of streptomycin in tuberculosis, tropical disease research, electrical activity of the central nervous system, and strains of influenza virus involved in the European epidemic last winter.

Grants to support heart research and to build heart research laboratory facilities have been made to 21 institutions by the National Heart Institute of the National Institutes of Health, Bethesda, Maryland, principal research branch of the Public Health Service. Totaling \$358,109, the grants include \$248,109 for 20 research investigations in 18 nonfederal institutions in 13 states and the District of Columbia, and \$110,000 to provide necessary research laboratory facilities for study of heart diseases in two nonfederal institutions. The largest sum—\$100,000—went to the Oklahoma Research Foundation to provide clinical facilities for cardiovascular research in a basic research plant now under construction. Other large grants included \$64,800 to Northwestern University for the investigation of rheumatic fever; \$33,976 to Western Reserve University, Cleveland, for experimental investigations to improve the circulation of the coronary arteries; and \$23,657 to the University of Chicago, for investigating the degenerative complications of diabetes as they affect the arteries.

The American Institute of Chemical Engineers presented the following awards at its annual meeting

last week in Pittsburgh: the William H. Walker Award for distinctive contribution to the literature of chemical engineering to William H. McAdams, professor of chemical engineering, Massachusetts Institute of Technology for his work in heat transfer; the Celanese Corporation of America Professional Progress Award in Chemical Engineering to Mott Souders, Jr., head of the Chemical Engineering Research Section of the Shell Development Company, Emeryville, California.

Nicholas J. Hoff, professor of Aeronautical Engineering at Polytechnic Institute of Brooklyn, has been awarded the Medal of the Swedish Society of Engineers. The medal was presented during Dr. Hoff's recent visit to Sweden in appreciation of his contributions to structural engineering, particularly for his work on the instability of airplane fuselages, the buckling of rigid jointed trusses, and the effects of concentrated loads on fuselage frames. Dr. Hoff is the first American aeronautical scientist to receive the medal.

Colleges and Universities

Programs for the spring sessions of the current Mechanics Colloquium at the Illinois Institute of Technology are as follows: January 4—"Frontier Problems of Fluid Mechanics" by H. L. Dryden, director, National Advisory Committee for Aeronautics; February 1—"The Mechanics of Earth Slides in Clays" by P. C. Rutledge, chairman, Department of Civil Engineering, Technological Institute, Northwestern University; March 1—"The Dynamic Behavior of Materials Having Hereditary Characteristics" by E. Volterra, associate professor of mechanics, Illinois Institute of Technology (to be held in the Technological Institute, Northwestern University, Evanston); April 5—"Modern Theories of Failure of Materials" by C. Zener, professor of physics, Institute for the Study of Metals, University of Chicago; and May 3—"Recent Problems in Vibration" by J. P. den Hartog, professor of mechanical engineering, Massachusetts Institute of Technology.

A series of meetings on fundamental problems on growth and malignancy is being presented by the Department of Pathology, University of Vermont and State Agricultural College, Burlington, Vermont. Speakers and topics for the forthcoming meetings are: January 5—Leonell C. Strong, professor of anatomy, Yale University School of Medicine, "Genetics and Cancer"; February 9—Albert J. Tannenbaum, director, Department of Cancer Research, Michael Reese Hospital, Chicago, "Diet and Cancer"; March 2—Van R. Potter, professor of oncology, University of Wisconsin Medical School, "Enzymes, Growth, and Cancer"; March 30—Roy Hertz, chief, Endocrinology Section, National Cancer Institute, Bethesda, Maryland, "Vitamin-Hormone Interrelationships Affecting Tissue Growth"; and May 4—Robert E. Stowell, professor of oncology, University of Kansas School of Medicine, "Nucleoproteins, Growth, and Cancer."

Industrial Laboratories

J. Murray Scott, medical director of Ayerst, McKenna and Harrison, New York and Montreal, has been appointed medical director of Sharp and Dohme, Inc., Philadelphia. Dr. Scott succeeds J. William Crosson, who has been named to fill the newly created position of medical administrator.

The American Optical Company, Southbridge, Massachusetts, has opened its new Stamford Research Laboratory at Stamford, Connecticut. Supplementing the research facilities and program of the company, the laboratory will be used for studies in geometrical optics, microscopy, photographic optics, spectroscopy, optical methods for research in nuclear physics, glass chemistry, instruments, and optical materials.

Meetings and Elections

The 75th Anniversary Meeting of the Cambridge Entomological Club will be held on December 20 at Harvard. The program will include an address by Marston Bates, author of *The natural history of*

mosquitoes and member of the staff of the Rockefeller Foundation, on "Entomological Research in the Tropics."

The Relation of Psychology to Medicine will be the subject of a conference to be held at the University of Pittsburgh February 9-10. This is the fourth of the series on current trends in psychology scheduled by the university's Department of Psychology. All members of the American Psychological Association and of the American Medical Association may obtain tickets of admission without charge by writing to the Department of Psychology, University of Pittsburgh.

The Federation of American Societies for Experimental Biology will hold its 34th annual meeting April 17-21, in Atlantic City, New Jersey. Affiliated societies are: The American Physiological Society; American Society of Biological Chemists; American Society for Pharmacology and Experimental Therapeutics; The American Society for Experimental Pathology; American Institute of Nutrition; and The American Association of Immunologists. Approximately 1600 papers will be presented in the fields of these societies. In addition, there will be a joint session of all six societies and several symposia. Attendance will be open to members of the constituent societies and their associates and to interested biologists in all countries.

Biologists in the fields represented by the federation may submit titles and abstracts of papers they wish to read to the secretary of the appropriate society, not later than January 10. Nonmembers must be introduced by a member. Scientific and technical exhibits may be made by individuals, laboratories, institutions, and industrial organizations. Further information may be obtained from the Federation Secretary, 2101 Constitution Avenue, Washington 25, D. C.

Scientists from the U. S. and Canada who have been invited to attend the symposium "Mécanisme de la Narcose" to be held in Paris April 19-26 are W. D. McElroy, Johns Hopkins University, Balti-

more; L. V. Heilbrunn, Zoological Laboratory, Philadelphia; and J. H. Quastel, Biochemical Department, McGill University, Montreal.

The American Chemical Society has chosen N. Howell Furman, Russell Wellman Moore Professor of Chemistry, Princeton University, as president elect; he will head the society in 1951. President for 1950 will be Ernest H. Volwiler, executive vice president of Abbott Laboratories, Chicago, who will take office on January 1, succeeding Linus Pauling, of the California Institute of Technology. The two new members of the Board of Directors, elected to serve three-year terms, are Raymond E. Kirk, head of the Chemistry Department, Polytechnic Institute of Brooklyn, and Farrington Daniels, Chemistry Department, University of Wisconsin.

The Pacific Division of the American Society of Limnology and Oceanography elected the following officers for 1950 at its June meeting with the AAAS in Vancouver, Canada: president, G. F. McEwen, LaJolla, California; vice president, W. T. Edmondson, Seattle, Washington; secretary-treasurer, John P. Tully, Nanaimo, British Columbia; members-at-large, Clifford A. Barnes, University of Washington; and Donald L. McKernan, Clackamas, Oregon.

The American Institute of Chemical Engineers has elected the following officers for 1950: president, Warren L. McCabe, vice president and director of research of the Flintkote Company; vice president, T. H. Chilton, technical director of the Development Engineering Division, E. I. duPont de Nemours and Company. S. L. Tyler and C. R. DeLong, both of New York City, were reelected secretary and treasurer respectively.

Deaths

Oliver Edwin Baker, 66, professor of geography at the University of Maryland, died December 2 at his home in College Park, Maryland. Head of the Geography Department since 1942, Dr. Baker had resigned

last July in order to devote more time to research. At the time of his death he was working with Charles Hu, of the Geography Department, on an atlas of China and an atlas of world resources.

Charles Kephart Swartz, 88, professor emeritus of geology at Johns Hopkins University since 1931, died November 26 at his home in Baltimore after an illness of several months. As a student at Heidelberg in 1888 he worked with Heinrich Hertz in the early experiments on Hertzian waves. Dr. Swartz was a former president of the American Paleontological Society and former vice president of the Geological Society of America.

George Joseph Brunner, 67, professor of geophysics at Saint Louis University, died November 22. He was an authority on deep earthquakes and his graphical method for determining their characteristics, published in 1943, is widely used.

Charles Robert Moulton, 65, assistant director of the Patent Division of the Argonne National Laboratory since 1946 and former University of Missouri chemistry professor, died in Chicago December 4 of a cerebral hemorrhage.

Walter L. Howard, 77, professor emeritus of pomology at the College of Agriculture of the University of California at Davis, died October 17. Dr. Howard was director at Davis from 1924 to 1937 and in addition to agricultural publications he had written a book about Luther Burbank.

Blindness caused by neutron radiation is being cured in the case of Alexander J. Allen, professor in charge of the University of Pittsburgh cyclotron, whose vision was impaired as he adjusted the cyclotron in the spring of 1948. Almost totally blind, he went last July to Columbia Presbyterian Medical Center in New York City, where Algernon Reese removed the lens of his right eye. Dr. Allen now wears spectacles with a thick right lens. His eye is showing steady improvement. Next summer a similar operation will be performed on his left eye, and it

is expected that his sight will be restored.

A new society of industrial microbiologists is to be organized to cover the borderline work in application of microbiological knowledge or processes to work with industrial materials. The society plans to handle such problems as deterioration and preservation of military and industrial materials, microbiologic manufacturing processes, and microbiologic assay. The organization meeting will be held Thursday, December 29 at 4:00 p.m. in the Hotel McAlpin Ballroom, in connection with the New York meeting of the American Association for the Advancement of Science.

The National Registry of Rare Chemicals, 35 West 33rd Street, Chicago, Illinois, has submitted the following list of wanted chemicals: phloretin; ribose-1-phosphate; 4-bromocyclohexanone; 4-methyl-4-bromocyclohexanone; 4,6-diaminoquinoline; potassium carbide; 1,7-dibromo-*n*-heptane; 1-methyl-2-methylene-1,2-dihydroquinoline; 6-aminoheptonic acid; 7-aminocaprylic acid; tin carbide; berbamine; indoxyllic acid; *D*-laudanoline; canadine; apiin; 2,3-dimercaptobutane; estriol glucuronate; barbatinic acid; and phrenosin.

A research clinic for multiple sclerosis and related disorders of the nervous system has been established at the Montefiore Hospital, in the Bronx, New York, through a grant from the National Multiple Sclerosis Society.

A training course for cardiovascular investigators, sponsored jointly by the U. S. Public Health Service, American Heart Association, and Western Reserve University School of Medicine, will be offered in the Department of Physiology for the second time, July 1, 1950-June 30, 1951. C. J. Wiggers will be in charge of the course, which will consist of formalized training in cardiovascular research methods, assistance to experienced investigators, supervision of independent research, and practice in manuscript preparation. Postdoctoral candidates accepted for training will be recommended to the

director of the National Heart Institute, U. S. Public Health Service, for a research traineeship carrying a stipend ranging from \$3,000 to \$3,600 per annum. A maximum of ten trainees can be accepted. For information and application blanks, address Dr. C. J. Wiggers, Program Director, Western Reserve University School of Medicine, Cleveland 6, Ohio.

Recently Received—

The Harvard Photographic Meteor Program. Fred L. Whipple. Harvard reprint 319. Harvard Observatory, Cambridge.

Excavations in Northeastern Massachusetts. Ripley P. Bullen. Papers of the Robert S. Peabody Foundation for Archaeology, Vol. 1, No. 3. Phillips Academy, Andover, Massachusetts.

Observations on the Plant Communities at "Bundemar," Trangie District, New South Wales, in relation to Chortocetes terminifera (Walk.) and Austroicetes cruciata (Sauss.). L. R. Clark. Bull. 236. Council for Scientific and Industrial Research, Melbourne, Australia.

The Shoulder Architecture of Bears and Other Carnivores. D. Dwight Davis. Fieldiana-Zoology, Vol. 31, No. 34, Chicago Natural History Museum. 25¢.

The Races of the African Wood-Dove Turtur Afer. A. L. Rand. Fieldiana-Zoology, Vol. 31, No. 35, Chicago Natural History Museum. 10¢.

Estudio Sobre las Serofosfatasas. I-Fosfatasa Alcalina. Elena Penini. Mercatali, Publisher, Avenida Acoyte 269, Buenos Aires, Argentina.

Subspecies of the Ridge-Nosed Rattlesnake, Crotalus Willardi. Laurence M. Klauber. (Reprint) San Diego Society of Natural History, San Diego, California.

The Boylston Street Fishweir II: A study of the geology, paleobotany, and biology of a site on Stuart Street in the Back Bay District of Boston, Massachusetts. Elso S. Barghoorn et al. Papers of the Robert S. Peabody Foundation for Archaeology, Vol. 4, No. 1. Phillips Academy, Andover, Massachusetts.